SAMPLE CONTENT

MHT-CET

TRIUMPH

MATHEMATICS

PART 2

BASED ON THE LATEST SYLLABUS OF MHT-CET

4343 MCQs

Differential equations are used to determine the age of dead organisms using carbon dating technique.

Std. XII

Mr. Vinod Singh
M.Sc. (Mathematics)

Ms. Suchitra Yadav
M.Sc. (Mathematics) B.Ed.

Mr. Shantanu R. Pal
B.E. (Electronics)

Ms. Varsha Talreja
B.E.

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Written in accordance with the latest MHT-CET Paper Pattern prescribed by
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MHT-CET TRIUMPH

MATHEMATICS

4343 MCQs

Based on the latest Syllabus of MHT-CET

PART 2 Std. XII

Salient Features

- Includes all the chapters of Std. XII as per the latest MHT-CET Syllabus
- Includes '4343' MCQs
- Quick Review and exhaustive subtopic wise coverage of MCQs
- Solved Previous Years' MHT-CET questions till 2023
- Evaluation Test for each chapter
- Two Model Question Papers with answer keys (Solutions provided through Q.R. codes)
- Two Question Papers & Answer Keys of MHT-CET 2023 (Solutions provided through Q.R. codes)
- Includes **Smart Keys** (Caution, Shortcuts & Thinking Hatke)
- 'Real-world applications' in each chapter
- Answer keys for all the chapters and Evaluation Tests at the end of book
- *Solutions to MCQs and Evaluation Test can be accessed through Q.R. code given at the end of each chapter*

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PREFACE

"Don't follow your dreams; chase them!" A quote by Richard Dumbrill is perhaps the most pertinent for one who is aiming to crack entrance examinations held after Std. XII. We are aware of the aggressive competition a student appearing for such career-defining examinations experiences and hence wanted to create books that develop the necessary knowledge, tools, and skills required to excel in these examinations.

For the syllabus of **MHT-CET**, 80% of the weightage is given to the syllabus for XII^{th} standard while only 20% is given to the syllabus for XI^{th} standard (with inclusion of only selected topics).

We believe that although the syllabus for Std. XII and XI and MHT-CET is aligned, the outlook for studying the subject should be altered based on the nature of the examination. To score well in the MHT-CET, a student has to be not just good with the concepts but also quick to complete the test successfully. Such ingenuity can be developed through sincere learning and dedicated practice.

As a first step to MCQ solving, students should start with elementary questions. Once momentum is gained, complex MCQs with a higher level of difficulty should be practised. Such holistic preparation is the key to succeeding in the examination!

Target's **Triumph MHT-CET Mathematics Standard XII** book which covers all the chapters of Std. XII has been designed to achieve the above objectives. Beginning with basic MCQs, the book proceeds to develop competence to solve complex MCQs. It offers ample practice of recent questions from MHT-CET examinations. It also includes solutions (via QR codes) that provide explanations to help students learn how to solve the MCQs. Relevant solutions are complemented by Alternate Methods.

The sections of **Quick Review** and **MCQs (Classical, Critical, Concept Fusion, Previous Years' MHT-CET Questions, Evaluation Test)** form the backbone of every chapter and ensure adequate revision.

To optimise learning efficiency, multiple study techniques are included in every chapter in the form of **Smart Keys** *(Shortcuts, Caution & Thinking Hatke)*.

The two **Model Question Papers** given at the end of the book are specially prepared to gauge the student's preparedness to appear for the MHT-CET examination. Two **MHT-CET 2023 Question Papers** have been provided to offer students a glimpse of the complexity of the questions asked in the examination.

All the features of this book pave the way for a student to excel in the examination. The features are designed keeping the following elements in mind: Time management, easy memorization or revision, and non-conventional yet simple methods for MCQ solving. The features of the book presented on the next page will explain more about them!

We hope the book benefits the learner as we have envisioned.

Publisher
Edition: Second

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.
Please write to us on: mail@targetpublications.org

FEATURES

Quick Review

Quick Review includes short and precise summary along with Tables and Key formulae in the chapter.
This is our attempt to make tools of formulae accessible at a glance for the students while solving problems.

Sub-topic wise Segregation

MCQs are **segregated sub-topic wise.**
This is our attempt to cater to individualistic pace and preferences of studying a chapter in students and enable easy assimilation of questions based on the specific concept.

Classical Thinking

Classical Thinking section encompasses straight forward questions including knowledge based questions.
This is our attempt to revise chapter in its basic form and warm up students to deal with complex MCQs.

Critical Thinking

Critical Thinking section encompasses challenging questions which test understanding, rational thinking and application skills of students.
This is our attempt to take students from beginner to proficient level in smooth steps.

Concept Fusion

Concept Fusion section encompasses questions whose solutions require knowledge of concepts covered in different sub-topics of same chapter or from different chapters.
This is our attempt to develop cognitive thinking in the students essential to solve questions involving fusion of multiple key concepts.

MHT-CET Previous Years' Questions

MHT-CET Previous Years' Questions section encompasses questions from MHT-CET examinations.
This is our attempt to give students practice of MHT-CET questions and advance them to acquire knack essential to solve such questions.

Continued…

FEATURES

Evaluation Test

Evaluation Test encompasses questions based on concepts covered in the entire chapter.
This is our attempt to allow self-assessment of the chapter

Smart Keys

Smart Keys comprise a set of remarkable study techniques contrived to benefit students.
This is our attempt to promote quick, innovative, and divergent thinking as well as enable the students to perceive the underlying depth and implications of concepts.

Caution

Caution apprises students about mistakes often made while solving MCQs.

Shortcuts

Shortcuts incorporate important theoretical or formula based short tricks, beneficial in solving MCQs.

Thinking Hatke

Thinking Hatke reveals quick witted approach to crack the specific question.

Real-world applications

Each chapter includes **real-world applications or examples** related to the concept discussed.
This is our attempt to link learning to the life and make students conscious of how Mathematics is related to everything we see, feel, touch and taste.

QR Code

QR Code includes
- Solutions to MCQs and Evaluation Test for each chapter
- Solutions to Model Question Papers I and II
- Solutions to MHT-CET 2023 Question Papers

MHT-CET PAPER PATTERN

- There will be three papers of Multiple Choice Questions (MCQs) in 'Mathematics', 'Physics and Chemistry' and 'Biology' of 100 marks each.
- Duration of each paper will be 90 minutes.
- Questions will be based on the syllabus prescribed by Maharashtra State Board of Secondary and Higher Secondary Education with approximately 20% weightage given to Std. XI and 80% weightage will be given to Std. XII curriculum.
- Difficulty level of questions will be at par with JEE (Main) for Mathematics, Physics, Chemistry and at par with NEET for Biology.
- There will be no negative marking.
- Questions will be mainly application based.
- Details of the papers are as given below:

Paper	Subject	Approximate No. of Multiple Choice Questions (MCQs) based on		Mark(s) Per Question	Total Marks
		Std. XI	Std. XII		
Paper I	Mathematics	10	40	2	100
Paper II	Physics	10	40	1	100
	Chemistry	10	40		
Paper III	Biology	20	80	1	100

- Questions will be set on
  i. the entire syllabus of Std. XII of Physics, Chemistry, Mathematics and Biology subjects and
  ii. chapters / units from Std. XI curriculum as mentioned below:

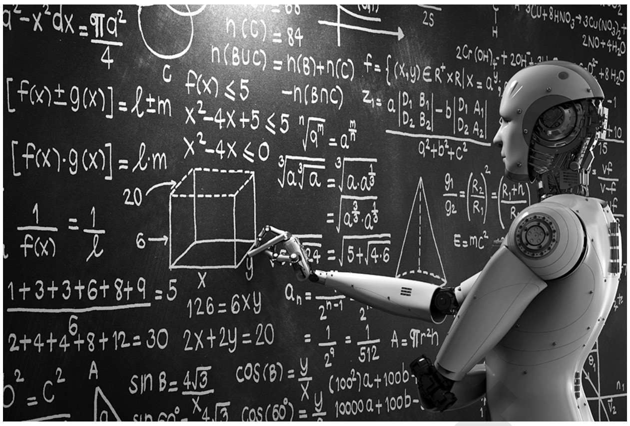
Sr. No.	Subject	Chapters / Units of Std. XI
1	Physics	Motion in a plane, Laws of motion, Gravitation, Thermal properties of matter, Sound, Optics, Electrostatics, Semiconductors
2	Chemistry	Some Basic Concepts of Chemistry, Structure of Atom, Chemical Bonding, Redox Reactions, Elements of Group 1 and Group 2, States of Matter: Gaseous and Liquid States, Basic Principles and techniques of Chemistry, Adsorption and Colloids, Hydrocarbons
3	Mathematics	Trigonometry - II, Straight Line, Circle, Measures of Dispersion, Probability, Complex Numbers, Permutations and Combinations, Functions, Limits, Continuity
4	Biology	Biomolecules, Respiration and Energy Transfer, Human Nutrition, Excretion and osmoregulation

CONTENTS

Chapter

1

Mathematical Logic



Mathematical Logic in artificial intelligence

The field of artificial intelligence (AI) has been consistently shaped by the profound influence of mathematical logic. Since its inception, AI researchers recognized the immense potential of automating logical inferences using technology, as it could facilitate effective problem-solving and drawing conclusions based on factual information.

Chapter Outline

1.1 Statement, Logical Connectives, Compound Statements and Truth Table
1.2 Statement Pattern, Logical Equivalence, and Algebra of Statements
1.3 Tautology, Contradiction, Contingency
1.4 Quantifiers and Quantified Statements, Duality
1.5 Negation of compound statements
1.6 Switching circuit

Quick Review

- **Statement**
  A statement is declarative sentence which is either true or false, but not both simultaneously.
- Statements are denoted by lower case letters p, q, r, etc.
- The truth value of a statement is denoted by '1' or 'T' for True and '0' or 'F' for False.
  Open sentences, imperative sentences, exclamatory sentences and interrogative sentences **are not considered as Statements** in Logic.

- **Logical connectives**

Type of compound statement	Connective	Symbol	Example
Conjuction	and	$\wedge$	p and q : $p \wedge q$
Disjunction	or	$\vee$	p or q : $p \vee q$
Negation	not	$\sim$	negation p : $\sim p$ not p : $\sim p$
Conditional or Implication	if….then	$\rightarrow$ or $\Rightarrow$	If p, then q : $p \rightarrow q$
Biconditional or Double implication	if and only if, i.e., iff	$\leftrightarrow$ or $\Leftrightarrow$	p iff q : $p \leftrightarrow q$

- When two or more simple statements are combined using logical connectives, then the statement so formed is called **Compound Statement**.
- Sub-statements are those simple statements which are used in a compound statement.
- In the conditional statement $p \rightarrow q$, p is called the antecedent or hypothesis, while q is called the consequent or conclusion.

➢ **Truth Tables for compound statements:**

- Conjuction, Disjunction, Conditional and Biconditional:

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

- Negation:

p	$\sim p$
T	F
F	T

➢ **Relation between compound statements and sets in set theory:**

Logic	Set Theory
Negation	complement of a set
Disjunction	union of two sets
Conjunction	intersection of two sets
Conditional	subset of a set
Biconditional	equality of two sets

➢ **Statement Pattern:**

When two or more simple statements p, q, r …. are combined using connectives $\wedge$, $\vee$, ~, $\rightarrow$, $\leftrightarrow$ the new statement formed is called a **statement pattern.**

e.g.: $\sim p \wedge q$, $p \wedge (p \wedge q)$, $(q \rightarrow p) \vee r$

➢ **Converse, Inverse, Contrapositive of a Statement:**

Conditional Statement	Converse	Inverse	Contrapositive
$p \rightarrow q$	$q \rightarrow p$	$\sim p \rightarrow \sim q$	$\sim q \rightarrow \sim p$

➢ **Logical equivalence:**

If two statement patterns have the same truth values in their respective columns of their joint truth table, then these two statement patterns are **logically equivalent.**

Consider the truth table:

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

From the given truth table, we can summarize the following:

- The given statement and its contrapositive are logically equivalent.
  i.e., $p \rightarrow q \equiv \sim q \rightarrow \sim p$
- The converse and inverse of the given statement are logically equivalent.
  i.e., $q \rightarrow p \equiv \sim p \rightarrow \sim q$

➢ **Algebra of statements:**

Idempotent Law	$p \vee p \equiv p$ $p \wedge p \equiv p$	**Identity Law**	$p \wedge T \equiv p$ $p \wedge F \equiv F$ $p \vee F \equiv p$ $p \vee T \equiv T$
Commutative Law	$p \vee q \equiv q \vee p$ $p \wedge q \equiv q \wedge p$	**Complement Law**	$p \wedge \sim p \equiv F$ $p \vee \sim p \equiv T$
Associative Law	$(p \vee q) \vee r \equiv p \vee (q \vee r)$ $\equiv p \vee q \vee r$	**Absorption Law**	$p \vee (p \wedge q) \equiv p$ $p \wedge (p \vee q) \equiv p$
	$(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$ $\equiv p \wedge q \wedge r$	**Conditional Law**	$p \rightarrow q \equiv \sim p \vee q$
Distributive Law	$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$ $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$	**Biconditional Law**	$p \leftrightarrow q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$ $\equiv (\sim p \vee q) \wedge (\sim q \vee p)$
De Morgan's Law	$\sim(p \vee q) \equiv \sim p \wedge \sim q$ $\sim(p \vee q) \equiv \sim p \wedge \sim q$		

➢ **Types of Statements:**

- If a statement is **always true**, then the statement is called a "**tautology**".
- If a statement is **always false**, then the statement is called a "**contradiction**" or a "**fallacy**".
- If a statement is **neither a tautology nor a contradiction,** then it is called "**contingency**".

➢ **Quantifiers and Quantified Statements:**

Quantifier Symbol	stands for	known as
$\forall$	"all values of " or "for every"	Universal Quantifier
$\exists$	"there exists atleast one"	Existential Quantifier

When a quantifier is used in an open sentence, it becomes a statement and is called a **Quantified Statement.**

➢ **Principles of Duality:**

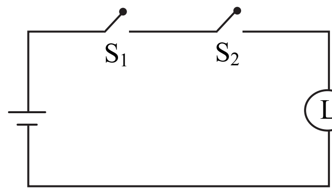
Two compound statements are said to be dual of each other, if one can be obtained from the other by replacing "$\wedge$" by "$\vee$" and vice versa. The connectives "$\wedge$" and "$\vee$" are duals of each other. If 't' is tautology and 'c' is contradiction, then the special statements 't' & 'c' are duals of each other.

➢ **Negation of a Statement:**

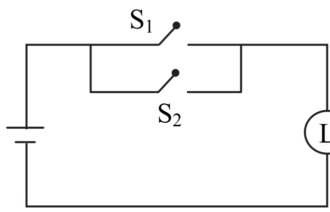
• $\sim(p \vee q) \equiv \sim p \wedge \sim q$	• $\sim(p \wedge q) \equiv \sim p \vee \sim q$	• $\sim(p \rightarrow q) \equiv p \wedge \sim q$
• $\sim(p \leftrightarrow q) \equiv (p \wedge \sim q) \vee (q \wedge \sim p)$	• $\sim(\sim p) \equiv p$	• $\sim(\exists\, x) \equiv \forall\, x$
• $\sim(\forall\, x) \equiv \exists\, x$	• $\sim(x < y) \equiv x \geq y$	• $\sim(x > y) \equiv x \leq y$

➢ **Application of Logic to Switching Circuits:**

- **AND : [$\wedge$] (Switches in series)**
  Let p : S_1 switch is ON
  q : S_2 switch is ON
  For the lamp L to be 'ON' both S_1 and S_2 must be ON
  Using theory of logic, the adjacent circuit can be expressed as, $\mathbf{p \wedge q}$.



- **OR : [$\vee$] (Switches in parallel)**
  Let p : S_1 switch is ON
  q : S_2 switch is ON
  For lamp L to be put ON either one of the two switches S_1 and S_2 must be ON.
  Using theory of logic, the adjacent circuit can be expressed as $\mathbf{p \vee q}$.



- If two or more switches open or close simultaneously then the switches are denoted by the same letter.
  If p : switch S is closed.
  $\sim$ p : switch S is open.
  If S_1 and S_2 are two switches such that if S_1 is open S_2 is closed and vice versa,
  then $S_1 \equiv \sim S_2$ or $S_2 \equiv \sim S_1$

Shortcuts

1. $p \rightarrow p \equiv T$
2. $p \rightarrow \sim p \equiv F$
3. $\sim p \rightarrow p \equiv p$
4. $T \rightarrow p \equiv p$
5. $p \rightarrow T \equiv T$
6. $F \rightarrow p \equiv p$
7. $p \rightarrow F \equiv \sim p$
8. $p \leftrightarrow p \equiv T$
9. $p \leftrightarrow \sim p \equiv F$
10. $\sim p \leftrightarrow p \equiv F$
11. $T \leftrightarrow p \equiv p$
12. $p \leftrightarrow T \equiv p$
13. $F \leftrightarrow p \equiv \sim p$
14. $p \leftrightarrow F \equiv \sim p$

Classical Thinking

1.1 Statement, Logical Connectives, Compound Statements and Truth Table

1. Which of the following is a statement in logic?
(A) Go away (B) How beautiful!
(C) $x > 5$ (D) $2 = 3$

2. Which of the following is a statement in logic?
(A) What a wonderful day!
(B) Shut up!
(C) What are you doing?
(D) Bombay is the capital of India.

3. p : There are clouds in the sky and q : it is not raining. The symbolic form is
(A) $p \rightarrow q$ (B) $p \rightarrow \sim q$
(C) $p \wedge \sim q$ (D) $\sim p \wedge q$

4. If p: The sun has set, q: The moon has risen, then symbolically the statement 'The sun has not set or the moon has not risen' is written as
(A) $p \wedge \sim q$ (B) $\sim q \vee p$
(C) $\sim p \wedge q$ (D) $\sim p \vee \sim q$

5. If p: Rohit is tall, q: Rohit is handsome, then the statement 'Rohit is tall or he is short and handsome' can be written symbolically as
(A) $p \vee (\sim p \wedge q)$ (B) $p \wedge (\sim p \vee q)$
(C) $p \vee (p \wedge \sim q)$ (D) $\sim p \wedge (\sim p \wedge \sim q)$

6. Assuming the first part of the statement as p, second as q and the third as r, the statement 'Candidates are present, and voters are ready to vote but no ballot papers' in symbolic form is
(A) $(p \vee q) \wedge \sim r$ (B) $(p \wedge \sim q) \wedge r$
(C) $(\sim p \wedge q) \wedge \sim r$ (D) $(p \wedge q) \wedge \sim r$

7. Let p be the proposition : Mathematics is interesting and let q be the proposition : 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 interesting and Mathematics is difficult.
(D) Mathematics is interesting or Mathematics is difficult.

8. Write verbally $\sim p \vee q$ where
p: She is beautiful; q: She is clever
(A) She is beautiful but not clever
(B) She is not beautiful or she is clever
(C) She is not beautiful or she is not clever
(D) She is beautiful and clever.

9. If p: Ram is lazy, q: Ram fails in the examination, then the verbal form of $\sim p \vee \sim q$ is
(A) Ram is not lazy and he fails in the examination.
(B) Ram is not lazy or he does not fail in the examination.
(C) Ram is lazy or he does not fail in the examination.
(D) Ram is not lazy and he does not fail in the examination.

10. A compound statement p or q is false only when
(A) p is false.
(B) q is false.
(C) both p and q are false.
(D) depends on p and q.

11. A compound statement p and q is true only when
(A) p is true.
(B) q is true.
(C) both p and q are true.
(D) none of p and q is true.

12. For the statements p and q '$p \rightarrow q$' is read as 'if p then q'. Here, the statement q is called
(A) antecedent.
(B) consequent.
(C) logical connective.
(D) prime component.

13. If p : Prakash passes the exam,
q : Papa will give him a bicycle.
Then the statement 'Prakash passing the exam, implies that his papa will give him a bicycle' can be symbolically written as
(A) $p \rightarrow q$ (B) $p \leftrightarrow q$
(C) $p \wedge q$ (D) $p \vee q$

14. If d: driver is drunk, a: driver meets with an accident, translate the statement 'If the Driver is not drunk, then he cannot meet with an accident' into symbols
(A) $\sim a \rightarrow \sim d$ (B) $\sim d \rightarrow \sim a$
(C) $\sim d \wedge a$ (D) $a \wedge \sim d$

15. If a: Vijay becomes a doctor,
b: Ajay is an engineer.
Then the statement 'Vijay becomes a doctor if and only if Ajay is an engineer' can be written in symbolic form as
(A) $b \leftrightarrow \sim a$ (B) $a \leftrightarrow b$
(C) $a \rightarrow b$ (D) $b \rightarrow a$

16. A compound statement $p \rightarrow q$ is false only when
(A) p is true and q is false.
(B) p is false but q is true.
(C) atleast one of p or q is false.
(D) both p and q are false.

17. 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

(A) $p \leftrightarrow (q \vee r)$ (B) $(p \wedge q) \rightarrow r$
(C) $p \rightarrow (q \vee r)$ (D) $p \rightarrow (q \wedge r)$

18. If m: Rimi likes calculus.
n: Rimi opts for engineering branch.
Then the verbal form of $m \rightarrow n$ is
(A) If Rimi opts for engineering branch then she likes calculus.
(B) If Rimi likes calculus then she does not opt for engineering branch.
(C) If Rimi likes calculus then she opts for engineering branch
(D) If Rimi likes engineering branch then she opts for calculus.

19. The statement "If x^2 is not even then x is not even", is the converse of the statement
(A) If x^2 is odd, then x is even
(B) If x is not even, then x^2 is not even
(C) If x is even, then x^2 is even
(D) If x is odd, then x^2 is even

20. The converse of the statement "If $x > y$, then $x + a > y + a$", is
(A) If $x < y$, then $x + a < y + a$
(B) If $x + a > y + a$, then $x > y$
(C) If $x < y$, then $x + a > y + a$
(D) If $x > y$, then $x + a < y + a$

21. If Ram secures 100 marks in maths, then he will get a mobile. The converse is
(A) If Ram gets a mobile, then he will not secure 100 marks in maths.
(B) If Ram does not get a mobile, then he will secure 100 marks in maths.
(C) If Ram will get a mobile, then he secures 100 marks in maths.
(D) None of these

22. The inverse of the statement "If you access the internet, then you have to pay the charges", is
(A) If you do not access the internet, then you do not have to pay the charges.
(B) If you pay the charges, then you accessed the internet.
(C) If you do not pay the charges, then you do not access the internet.
(D) You have to pay the charges if and only if you access the internet.

23. The contrapositive of the statement: "If a child concentrates then he learns" is
(A) If a child does not concentrate he does not learn.
(B) If a child does not learn then he does not concentrate.
(C) If a child practises then he learns.
(D) If a child concentrates, he does not forget.

24. If p: Sita gets promotion,
q: Sita is transferred to Pune.
The verbal form of $\sim p \leftrightarrow q$ is written as
(A) Sita gets promotion and Sita gets transferred to Pune.
(B) Sita does not get promotion then Sita will be transferred to Pune.
(C) Sita gets promotion if Sita is transferred to Pune.
(D) Sita does not get promotion if and only if Sita is transferred to Pune.

25. Negation of a statement in logic corresponds to _______ in set theory.
(A) empty set
(B) null set
(C) complement of a set
(D) universal set

26. The logical statement '$p \wedge q$' can be related to the set theory's concept of
(A) union of two sets
(B) intersection of two set
(C) subset of a set
(D) equality of two sets

27. If p and q are two logical statements and A and B are two sets, then $p \rightarrow q$ corresponds to
(A) $A \subseteq B$ (B) $A \cap B$
(C) $A \cup B$ (D) $A \not\subseteq B$

1.2 Statement Pattern, Logical Equivalence, and Algebra of Statements

1. The statement $p \rightarrow (\sim q)$ is equivalent to
(A) $q \rightarrow p$ (B) $\sim q \vee \sim p$
(C) $p \wedge \sim q$ (D) $\sim q \rightarrow p$

2. Every conditional statement is equivalent to
(A) its contrapositive (B) its inverse
(C) its converse (D) only itself

3. The logically equivalent statement of $p \leftrightarrow q$ is
(A) $(p \wedge q) \vee (q \rightarrow p)$
(B) $(p \wedge q) \rightarrow (p \vee q)$
(C) $(p \rightarrow q) \wedge (q \rightarrow p)$
(D) $(p \wedge q) \vee (p \wedge q)$

4. The statement, 'If it is raining then I will go to college' is equivalent to
(A) If it is not raining then I will not go to college.
(B) If I do not go to college, then it is not raining.
(C) If I go to college then it is raining.
(D) Going to college depends on my mood.

5. The logically equivalent statement of $(p \wedge q) \vee (p \wedge r)$ is
(A) $p \vee (q \wedge r)$ (B) $q \vee (p \wedge r)$
(C) $p \wedge (q \vee r)$ (D) $q \wedge (p \vee r)$

6. The Boolean Expression $(p \wedge \sim q) \vee q \vee (\sim p \wedge q)$ is equivalent to:
(A) $p \wedge q$ (B) $p \vee q$
(C) $p \vee \sim q$ (D) $\sim p \wedge q$

1.3 Tautology, Contradiction, Contingency

1. $(p \wedge \sim q) \wedge (\sim p \wedge q)$ is a
(A) Tautology
(B) Contradiction
(C) Tautology and contradiction
(D) Contingency

2. When the compound statement is true for all its components then the statement is called
(A) negation statement.
(B) tautology statement.
(C) contradiction statement.
(D) contingency statement.

3. The statement $(p \wedge q) \to p$ is
(A) a contradiction (B) a tautology
(C) either (A) or (B) (D) a contingency

4. The proposition $(p \wedge q) \wedge (p \to \sim q)$ is
(A) Contradiction
(B) Tautology
(C) Contingency
(D) Tautology and Contradiction

5. The proposition $(p \to \sim p) \wedge (\sim p \to p)$ is a
(A) Neither tautology nor contradiction
(B) Tautology
(C) Tautology and contradiction
(D) Contradiction

6. The proposition $p \to \sim(p \wedge \sim q)$ is a
(A) contradiction.
(B) tautology.
(C) contingency.
(D) none of these

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

1.4 Quantifiers and Quantified Statements, Duality

1. Using quantifier the open sentence '$x^2 - 4 = 32$' defined on W is converted into true statement as
(A) $\forall x \in W, x^2 - 4 = 32$
(B) $\exists x \in W$, such that $x^2 - 4 \le 32$
(C) $\forall x \in W, x^2 - 4 > 32$
(D) $\exists x \in W$, such that $x^2 - 4 = 32$

2. Using quantifiers $\forall$, $\exists$, convert the following open statement into true statement.
'$x + 5 = 8, x \in N$'
(A) $\forall x \in N, x + 5 = 8$
(B) For every $x \in N, x + 5 > 8$
(C) $\exists x \in N$, such that $x + 5 = 8$
(D) For every $x \in N, x + 5 < 8$

3. The dual of the statement "Manoj has the job but he is not happy" is
(A) Manoj has the job or he is not happy.
(B) Manoj has the job and he is not happy.
(C) Manoj has the job and he is happy.
(D) Manoj does not have the job and he is happy.

4. Dual of the statement $(p \wedge q) \vee \sim q \equiv p \vee \sim q$ is
(A) $(p \vee q) \vee \sim q \equiv p \vee \sim q$
(B) $(p \wedge q) \wedge \sim q \equiv p \wedge \sim q$
(C) $(p \vee q) \wedge \sim q \equiv p \wedge \sim q$
(D) $(\sim p \vee \sim q) \wedge q \equiv \sim p \wedge q$

1.5 Negation of compound statements

1. The negation of $(p \vee \sim q) \wedge q$ is
(A) $(\sim p \vee q) \wedge \sim q$ (B) $(p \wedge \sim q) \vee q$
(C) $(\sim p \wedge q) \vee \sim q$ (D) $(p \wedge \sim q) \vee \sim q$

2. The negation of the statement
" I like Mathematics and English" is
(A) I do not like Mathematics and do not like English
(B) I like Mathematics but do not like English
(C) I do not like Mathematics but like English
(D) Either I do not like Mathematics or do not like English

3. Negation of the statement: '$\sqrt{5}$ is an integer or 5 is irrational' is
(A) $\sqrt{5}$ is not an integer or 5 is not irrational
(B) $\sqrt{5}$ is irrational or 5 is an integer
(C) $\sqrt{5}$ is an integer and 5 is irrational
(D) $\sqrt{5}$ is not an integer and 5 is not irrational

4. ~(p ↔ q) is equivalent to
   (A) $(p \wedge \sim q) \vee (q \wedge \sim p)$
   (B) $(p \vee \sim q) \wedge (q \vee \sim p)$
   (C) $(p \rightarrow q) \wedge (q \rightarrow p)$
   (D) $(q \rightarrow p) \vee (p \rightarrow q)$

5. The negation of 'If it is Sunday then it is a holiday' is
   (A) It is a holiday but not a Sunday.
   (B) No Sunday then no holiday.
   (C) It is Sunday, but it is not a holiday,
   (D) No holiday therefore no Sunday.

6. The negation of $q \vee \sim(p \wedge r)$ is
   (A) $\sim q \wedge \sim(p \vee r)$
   (B) $\sim q \wedge (p \wedge r)$
   (C) $\sim q \vee (p \wedge r)$
   (D) $\sim q \vee (p \wedge r)$

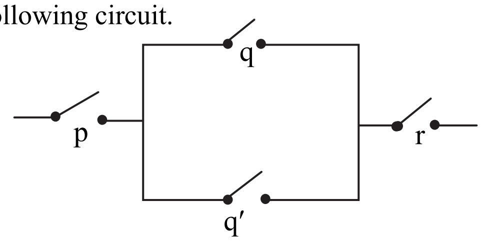
7. Which of the following is always true?
   (A) $\sim(p \rightarrow q) \equiv \sim q \rightarrow \sim p$
   (B) $\sim(p \vee q) \equiv p \vee \sim q$
   (C) $\sim(p \rightarrow q) \equiv p \wedge \sim q$
   (D) $\sim(p \vee q) \equiv \sim p \ \vee \sim q$

8. The negation of 'For every natural number x, $x + 5 > 4$' is
   (A) $\forall x \in N, x + 5 < 4$
   (B) $\forall x \in N, x - 5 < 4$
   (C) For every integer x, $x + 5 < 4$
   (D) There exists a natural number x, for which $x + 5 \leq 4$

9. The negation of the statement "All continuous functions are differentiable"
   (A) Some continuous functions are differentiable
   (B) All differentiable functions are continuous
   (C) All continuous functions are not differentiable
   (D) Some continuous functions are not differentiable

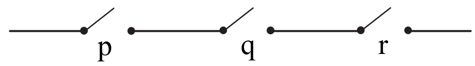
1.6 Switching circuit

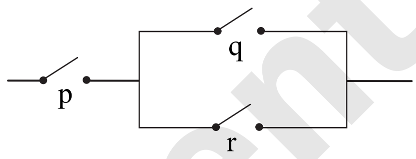
1. When does the current flow through the following circuit.

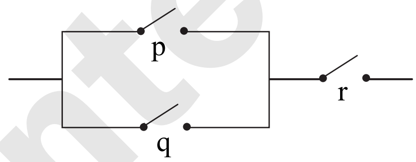


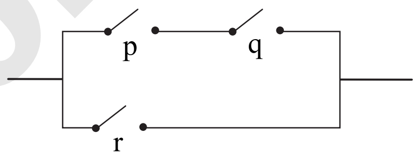
   (A) p, q should be closed and r is open
   (B) p, q, r should be open
   (C) p, q, r should be closed
   (D) none of these

2. The switching circuit for the statement $p \wedge q \wedge r$ is

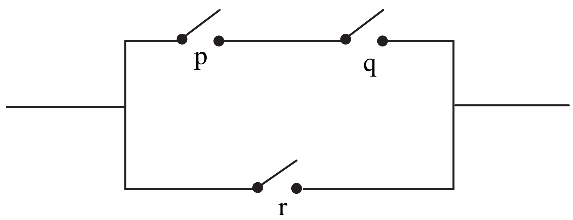
(A)


(B)


(C)


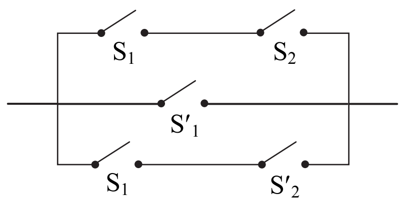
(D)


3. If the current flows through the given circuit, then it is expressed symbolically as,



   (A) $(p \wedge q) \vee r$ (B) $(p \wedge q)$
   (C) $(p \vee q)$ (D) $(p \vee q) \wedge r$

4. The switching circuit



in symbolic form of logic, is
   (A) $(p \wedge q) \vee (\sim p) \vee (p \wedge \sim q)$
   (B) $(p \vee q) \vee (\sim p) \vee (p \wedge \sim q)$
   (C) $(p \wedge q) \wedge (\sim p) \vee (p \wedge \sim q)$
   (D) $(p \vee q) \wedge (\sim p) \vee (p \wedge \sim q)$

Critical Thinking

1.1 Statement, Logical Connectives, Compound Statements and Truth Table

1. Which of the following is not a correct statement?
(A) Mathematics is interesting.
(B) $\sqrt{3}$ is a prime.
(C) $\sqrt{2}$ is irrational.
(D) The sun is a star.

2. Which of the following is an incorrect statement in logic ?
(A) Multiply the numbers 3 and 10.
(B) 3 times 10 is equal to 40.
(C) What is the product of 3 and 10?
(D) 10 times 3 is equal to 30.

3. Assuming the first part of the sentence as p and the second as q, write the following statement symbolically:
'Irrespective of one being lucky or not, one should not stop working'
(A) $(p \wedge \sim p) \vee q$ (B) $(p \vee \sim p) \wedge q$
(C) $(p \vee \sim p) \wedge \sim q$ (D) $(p \wedge \sim p) \vee \sim q$

4. If first part of the sentence is p and the second is q, then the symbolic form of the statement 'It is not true that Physics is not interesting or difficult' is
(A) $\sim(\sim p \wedge q)$ (B) $(\sim p \vee q)$
(C) $(\sim p \vee \sim q)$ (D) $\sim(\sim p \vee q)$

5. The symbolic form of the statement 'It is not true that intelligent persons are neither polite nor helpful' is
(A) $\sim(p \vee q)$ (B) $\sim(\sim p \wedge \sim q)$
(C) $\sim(\sim p \vee \sim q)$ (D) $\sim(p \wedge q)$

6. Let p: roses are red and q : the sun is a star. Then the verbal translation of $(\sim p) \vee q$ is
(A) Roses are not red and the sun is not a star.
(B) It is not true that roses are red or the sun is not a star.
(C) It is not true that roses are red and the sun is not a star.
(D) Roses are not red or the sun is a star.

7. Given 'p' and 'q' as true and 'r' as false, the truth values of $\sim p \wedge (q \vee \sim r)$ and $(p \to q) \wedge r$ are respectively
(A) T, F (B) F, F
(C) T, T (D) F, T

8. If p and q have truth value 'F', then the truth values of $(\sim p \vee q) \leftrightarrow \sim(p \wedge q)$ and $\sim p \leftrightarrow (p \to \sim q)$ are respectively
(A) T, T (B) F, F
(C) T, F (D) F, T

9. If p is true and q is false then the truth values of $(p \to q) \leftrightarrow (\sim q \to \sim p)$ and $(\sim p \vee q) \wedge (\sim q \vee p)$ are respectively
(A) F, F (B) F, T
(C) T, F (D) T, T

10. If p is false and q is true, then
(A) $p \wedge q$ is true (B) $p \vee \sim q$ is true
(C) $q \to p$ is true (D) $p \to q$ is true

11. Given that p is 'false' and q is 'true' then the statement which is 'false' is
(A) $\sim p \to \sim q$ (B) $p \to (q \wedge p)$
(C) $p \to \sim q$ (D) $q \to \sim p$

12. If p, q are true and r is false statement then which of the following is true statement?
(A) $(p \wedge q) \vee r$ is F
(B) $(p \wedge q) \to r$ is T
(C) $(p \vee q) \wedge (p \vee r)$ is T
(D) $(p \to q) \leftrightarrow (p \to r)$ is T

13. If $p \to (\sim p \vee q)$ is false, the truth values of p and q are respectively
(A) F, T (B) F, F
(C) T, T (D) T, F

14. If $p \to (p \wedge \sim q)$ is false, then the truth values of p and q are respectively.
(A) F, F (B) T, F
(C) T, T (D) F, T

15. If $\sim q \vee p$ is F, then which of the following is correct?
(A) $p \leftrightarrow q$ is T (B) $p \to q$ is T
(C) $q \to p$ is T (D) $p \to q$ is F

16. The converse of the contrapositive of $p \to q$ is
(A) $\sim p \to q$ (B) $p \to \sim q$
(C) $\sim p \to \sim q$ (D) $\sim q \to p$

17. The converse of 'If x is zero then we cannot divide by x' is
(A) If we cannot divide by x then x is zero.
(B) If we divide by x then x is non-zero.
(C) If x is non-zero then we can divide by x.
(D) If we cannot divide by x then x is non-zero.

18. The contrapositive of the statement "If you are born in India, then you are a citizen of India", is
(A) If you are a citizen of India, then you are born in India.
(B) If you are born in India, then you are not a citizen of India.
(C) If you are not a citizen of India, then you are not born in India.
(D) If you are not born in India, then you are not a citizen of India.

1.2 Statement Pattern, Logical Equivalence, and Algebra of Statements

1. The statement $p \to (q \to p)$ is equivalent to
(A) $p \to (p \wedge q)$ (B) $p \to (p \leftrightarrow q)$
(C) $p \to (p \to q)$ (D) $p \to (p \vee q)$

2. Find out which of the following statements have the same meaning:
i. If Seema solves a problem then she is happy.
ii. If Seema does not solve a problem then she is not happy.
iii. If Seema is not happy then she hasn't solved the problem.
iv. If Seema is happy then she has solved the problem
(A) (i, ii) and (iii, iv) (B) i, ii, iii
(C) (i, iii) and (ii, iv) (D) ii, iii, iv

3. Find which of the following statements convey the same meanings?
i. If it is the bride's dress then it has to be red.
ii. If it is not bride's dress then it cannot be red.
iii. If it is a red dress then it must be the bride's dress.
iv. If it is not a red dress then it can't be the bride's dress.
(A) (i, iv) and (ii, iii) (B) (i, ii) and (iii, iv)
(C) (i), (ii), (iii) (D) (i, iii) and (ii, iv)

4. $p \wedge (p \to q)$ is logically equivalent to
(A) $p \vee q$ (B) $\sim p \vee q$
(C) $p \wedge q$ (D) $p \vee \sim q$

5. Which of the following is true?
(A) $p \wedge \sim p \equiv T$
(B) $p \vee \sim p \equiv F$
(C) $p \to q \equiv q \to p$
(D) $p \to q \equiv (\sim q) \to (\sim p)$

6. Which of the following is NOT equivalent to $p \to q$.
(A) p is sufficient for q
(B) p only if q
(C) q is necessary for p
(D) q only if p

7. The statement pattern $(p \wedge q) \wedge [\sim r \vee (p \wedge q)] \vee (\sim p \wedge q)$ is equivalent to
(A) $p \wedge q$ (B) r
(C) p (D) q

8. The logical statement $(p \to q) \wedge (q \to \sim p)$ is equivalent to:
(A) p (B) $\sim q$
(C) q (D) $\sim p$

1.3 Tautology, Contradiction, Contingency

1. Which of the following is not true for any two statements p and q?
(A) $\sim[p \vee (\sim q)] \equiv \sim p \wedge q$
(B) $(p \vee q) \vee (\sim q)$ is a tautology
(C) $\sim(p \wedge \sim p)$ is a tautology
(D) $\sim(p \vee q) \equiv \sim p \vee \sim q$

2. $\sim(\sim p) \leftrightarrow p$ is
(A) a tautology
(B) a contradiction
(C) neither a contradiction nor a tautology
(D) none of these

3. Which one of the following statements is not a tautology?
(A) $p \to (p \vee q)$
(B) $(p \wedge q) \to (\sim p \vee q)$
(C) $(p \wedge q) \to p$
(D) $(p \vee q) \to (p \vee \sim q)$

4. Which of the following statements is a tautology?
(A) $\sim(p \wedge \sim q) \to (p \vee q)$
(B) $(\sim p \vee \sim q) \to (p \wedge q)$
(C) $p \vee (\sim q) \to (p \wedge q)$
(D) $\sim(p \vee \sim q) \to (p \vee q)$

5. Which of the following is a tautology?
(A) $p \to (p \wedge q)$
(B) $q \wedge (p \to q)$
(C) $\sim(p \to q) \leftrightarrow p \wedge \sim q$
(D) $(p \wedge q) \leftrightarrow \sim q$

6. $(\sim p \wedge \sim q) \wedge (q \wedge r)$ is a
(A) tautology
(B) contingency
(C) contradiction
(D) neither tautology nor contradiction

7. Which of the following statement is contradiction?
(A) $(p \wedge q) \to q$
(B) $(p \wedge \sim q) \wedge (p \to q)$
(C) $p \to \sim (p \wedge \sim q)$
(D) $(p \wedge q) \vee \sim q$

8. Which of the following statement is a contingency?
(A) $(p \wedge \sim q) \vee \sim(p \wedge \sim q)$
(B) $(p \wedge q) \leftrightarrow (\sim p \to \sim q)$
(C) $(\sim q \wedge p) \vee (p \vee \sim p)$
(D) $(q \to p) \vee (\sim p \leftrightarrow q)$

9. The false statement in the following is
(A) $p \wedge (\sim p)$ is a contradiction
(B) $p \vee (\sim p)$ is a tautology
(C) $\sim (\sim p) \leftrightarrow p$ is tautology
(D) $(p \to q) \leftrightarrow (\sim q \to \sim p)$ is a contradiction

1.4 Quantifiers and Quantified Statements, Duality

1. Using quantifier the open sentence ‘$x^2 > 0$’ defined on N is converted into true statement as
   (A) $\forall x \in N, x^2 > 0$
   (B) $\forall x \in N, x^2 = 0$
   (C) $\exists x \in N$, such that $x^2 < 0$
   (D) $\exists x \notin N$, such that $x^2 < 0$

2. If A ≡ {4, 5, 7, 9}, determine which of the following quantified statement is true.
   (A) $\exists\, x \in A$, such that $x + 4 = 7$
   (B) $\forall\, x \in A, x + 1 \le 10$
   (C) $\forall\, x \in A, 2x \le 17$
   (D) $\exists\, x \in A$, such that $x + 1 > 10$

3. Which of the following quantified statement is false?
   (A) $\exists x \in N$, such that $x + 5 \le 6$
   (B) $\forall x \in N, x^2 \nleq 0$
   (C) $\exists x \in N$, such that $x - 1 < 0$
   (D) $\exists x \in N$, such that $x^2 - 3x + 2 = 0$

4. The dual of ‘$(p \wedge t) \vee (c \wedge \sim q)$’ where t is a tautology and c is a contradiction, is
   (A) $(p \vee c) \wedge (t \vee \sim q)$
   (B) $(\sim p \wedge c) \wedge (t \vee q)$
   (C) $(\sim p \vee c) \wedge (t \vee q)$
   (D) $(\sim p \vee t) \wedge (c \vee \sim q)$

5. Given below are four statements along with their respective duals. Which dual statement is not correct?
   (A) $(p \vee q) \wedge (r \vee s), (p \wedge q) \vee (r \wedge s)$
   (B) $(p \vee \sim q) \wedge (\sim p), (p \wedge \sim q) \vee (\sim p)$
   (C) $(p \wedge q) \vee r, (p \vee q) \wedge r$
   (D) $(p \vee q) \vee s, (p \wedge q) \vee s$

1.5 Negation of compound statements

1. The Boolean expression $\sim(p \vee q) \vee (\sim p \wedge q)$ is equivalent to
   (A) p (B) q
   (C) ~ q (D) ~ p

2. The negation of $p \vee (\sim q \wedge \sim p)$ is
   (A) $\sim p \wedge q$ (B) $p \vee \sim q$
   (C) $\sim p \wedge \sim q$ (D) $\sim p \vee \sim q$

3. The negation of the Boolean expression $\sim s \vee (\sim r \wedge s)$ is equivalent to:
   (A) $\sim s \wedge \sim r$ (B) r
   (C) $s \wedge r$ (D) $s \vee r$

4. The Boolean expression $\sim(p \to \sim q)$ is equivalent to:
   (A) $p \wedge q$ (B) $(\sim p) \to q$
   (C) $q \to \sim p$ (D) $p \vee q$

5. For any two statements p and q, the negation of the expression $p \vee (\sim p \wedge q)$ is:
   (A) $\sim p \vee \sim q$ (B) $p \leftrightarrow q$
   (C) $p \wedge q$ (D) $\sim p \wedge \sim q$

6. Which of the following is logically equivalent to $\sim[p \to (p \vee \sim q)]$?
   (A) $p \vee (\sim p \wedge q)$ (B) $p \wedge (\sim p \wedge q)$
   (C) $p \wedge (p \vee \sim q)$ (D) $p \vee (p \wedge \sim q)$

7. 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.

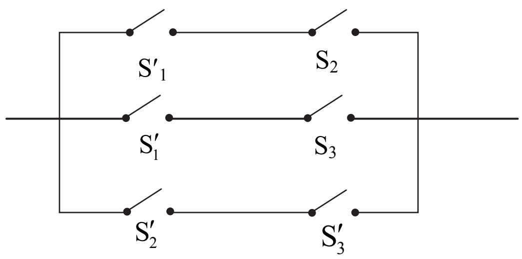
8. The negation of the statement “If Saral Mart does not reduce the prices, I will not shop there any more” is
   (A) Saral Mart reduces the prices and still I will shop there.
   (B) Saral Mart reduces the prices and I will not shop there.
   (C) Saral Mart does not reduce the prices and still I will shop there.
   (D) Saral Mart does not reduce the prices or I will shop there.

9. The negation of the statement, $\exists\, x \in R$, such that $x^2 + 3 > 0$, is
   (A) $\exists\, x \in R$, such that $x^2 + 3 < 0$
   (B) $\forall\, x \in R, x^2 + 3 > 0$
   (C) $\forall\, x \in R, x^2 + 3 \le 0$
   (D) $\exists\, x \in R$, such that $x^2 + 3 = 0$

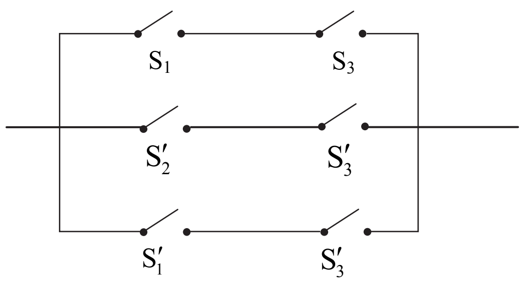
1.6 Switching circuit

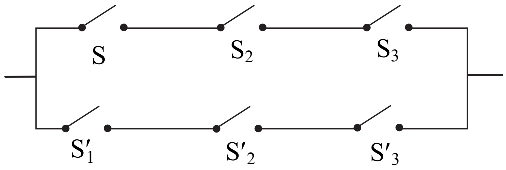
1. If the symbolic form is $(p \wedge r) \vee (\sim q \wedge \sim r) \vee (\sim p \wedge \sim r)$, then switching circuit is

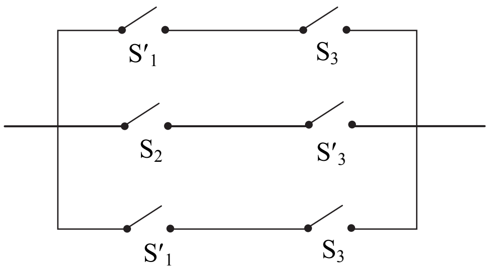
(A)



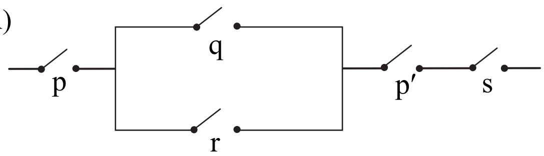
(B)

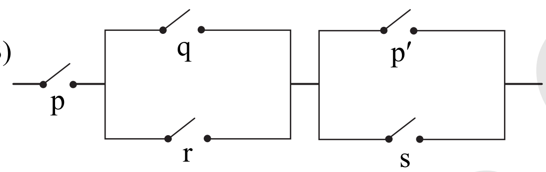


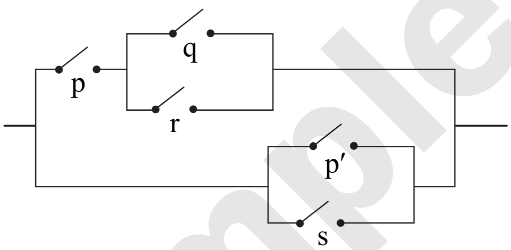
(C)


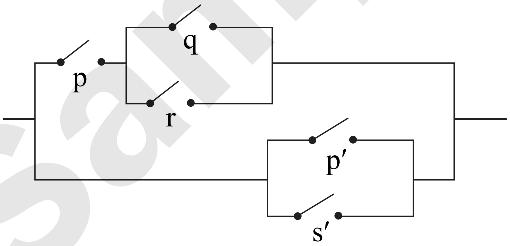
(D)


2. The switching circuit for the statement $[p \wedge (q \vee r)] \vee (\sim p \vee s)$ is

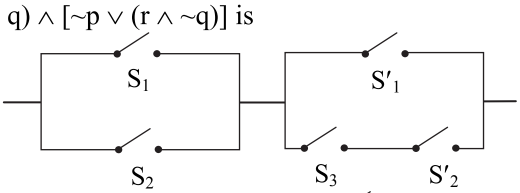
(A)


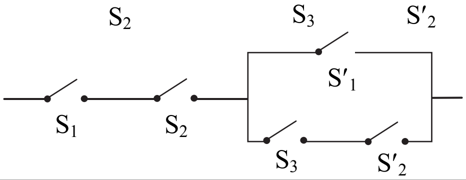
(B)


(C)


(D)


3. The switching circuit for the symbolic form $(p \vee q) \wedge [\sim p \vee (r \wedge \sim q)]$ is

(A)


(B)


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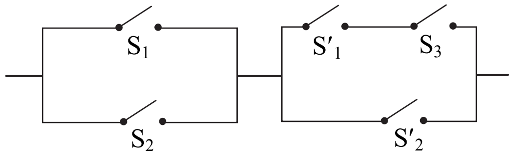
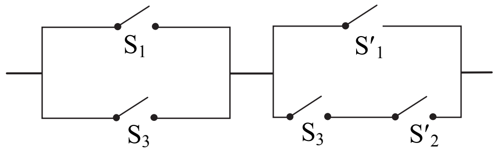
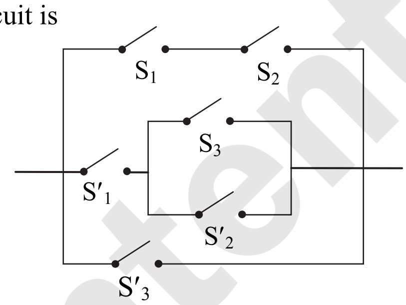


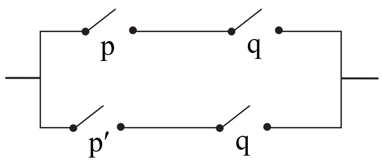
(D)


4. The symbolic form of logic for the following circuit is



(A) $(p \vee q) \wedge (\sim p \wedge r \vee \sim q) \vee \sim r$
(B) $(p \wedge q) \wedge (\sim p \vee r \wedge \sim q) \vee \sim r$
(C) $(p \wedge q) \vee [\sim p \wedge (r \vee \sim q)] \vee \sim r$
(D) $(p \vee q) \wedge [\sim p \vee (r \wedge \sim q)] \vee \sim r$

5. The simplified circuit for the following circuit is



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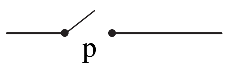

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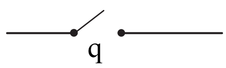
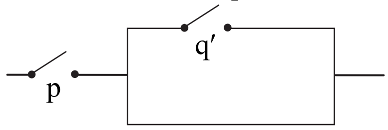
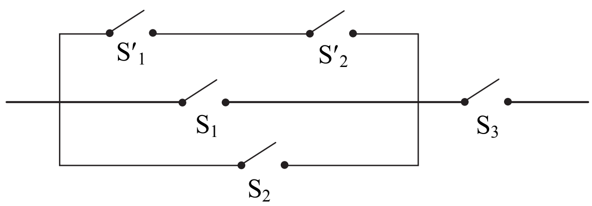


(C)


(D)


6. The simplified circuit for the following circuit is



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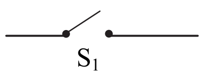
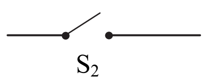
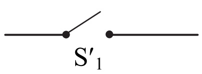
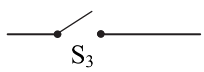


(B)


(C)


(D)


Concept Fusion

1. The statement ~(p $\leftrightarrow$ ~q) is
(A) a tautology
(B) a fallacy
(C) equivalent to p $\leftrightarrow$ q
(D) equivalent to ~p $\leftrightarrow$ q

2. The negation of the statement "72 is divisible by 2 and 3" is
(A) 72 is not divisible by 2 or 72 is not divisible by 3.
(B) 72 is divisible by 2 or 72 is divisible by 3.
(C) 72 is divisible by 2 and 72 is divisible by 3.
(D) 72 is not divisible by 2 and 3.

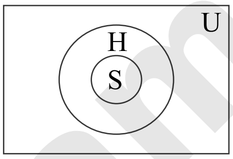
3. Let p : 7 is not greater than 4
and q : Paris is in France
be two statements. Then ~(p $\vee$ q) is the statement
(A) 7 is greater than 4 or Paris is not in France.
(B) 7 is not greater than 4 and Paris is not in France.
(C) 7 is not greater than 4 and Paris is in France.
(D) 7 is greater than 4 and Paris is not in France.

4. 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

MHT-CET Previous Years' Questions

1. p : A man is happy
q : The man is rich.
The symbolic representation of "If a man is not rich then he is not happy" is **[2004]**
(A) ~ p $\rightarrow$ ~ q (B) ~ q $\rightarrow$ ~ p
(C) p $\rightarrow$ q (D) p $\rightarrow$ ~ q

2. If U: Set of all days,
S: Set of Sundays,
H: Set of holidays, then,
Venn diagram for "Sunday implies holiday" is **[2004]**

(A)


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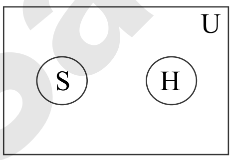
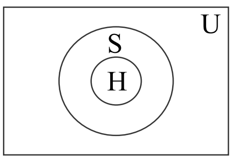
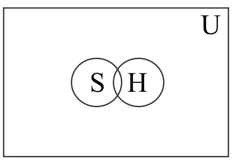


(C)


(D)


3. Which of the following statement is not a statement in logic? **[2005]**
(A) Earth is a planet.
(B) Plants are living object.
(C) $\sqrt{-9}$ is a rational number.
(D) I am lying.

4. Negation of (p $\wedge$ q) $\rightarrow$ (~ p $\vee$ r) is **[2005]**
(A) (p $\vee$ q) $\wedge$ (p $\wedge$ ~ r)
(B) (p $\wedge$ q) $\vee$ (p $\wedge$ ~ r)
(C) (p $\wedge$ q) $\wedge$ (p $\wedge$ ~ r)
(D) (p $\vee$ q) $\vee$ (p $\wedge$ ~ r)

5. Negation of p $\leftrightarrow$ q is **[2005]**
(A) (p $\wedge$ q) $\vee$ (p $\wedge$ q)
(B) (p $\wedge$ ~ q) $\vee$ (q $\wedge$ ~ p)
(C) (~ p $\wedge$ q) $\vee$ (q $\wedge$ p)
(D) (p $\wedge$ q) $\vee$ (~ q $\wedge$ p)

6. Negation of the statement 'A is rich but silly' is **[2006]**
(A) Either A is not rich or not silly.
(B) A is poor or clever.
(C) A is rich or not silly.
(D) A is either rich or silly.

7. The negation of the statement given by "He is rich and happy" is **[2006]**
(A) He is not rich and not happy
(B) He is rich but not happy
(C) He is not rich but happy
(D) Either he is not rich or he is not happy

8. If p : $x > y$; q > z; r : $x > z$, then which of the options represents 'If $x > y$ and $y > z$, then $x > z$'? **[2006]**

(A) $(p \vee q) \rightarrow r$ (B) $(p \vee q) \rightarrow \sim q$

(C) $(p \wedge \sim q) \rightarrow q$ (D) $(\sim p \wedge q) \wedge q$

9. If p and q are true statements in logic, which of the following statement pattern is true? **[2007]**

(A) $(p \vee q) \wedge \sim q$ (B) $(p \vee q) \rightarrow \sim q$

(C) $(p \wedge \sim q) \rightarrow q$ (D) $(\sim p \wedge q) \wedge q$

10. $\sim (\sim p \wedge \sim q)$ is equivalent to **[2007]**

(A) $p \wedge q$ (B) $p \rightarrow q$

(C) $p \vee q$ (D) $p \leftrightarrow q$

11. $(p \rightarrow \sim p) \vee (\sim p \rightarrow p)$ is equivalent to **[2008]**

(A) $T \rightarrow F$ (B) $p \wedge \sim p$

(C) $T \vee p$ (D) $T \leftrightarrow F$

12. p: Ram is rich
q: Ram is successful
r: Ram is talented
Write the symbolic form of the given statement.
Ram is neither rich nor successful and he is not talented **[2008]**

(A) $\sim p \wedge \sim q \vee \sim r$ (B) $\sim p \vee \sim q \wedge \sim r$

(C) $\sim p \vee \sim q \vee \sim r$ (D) $\sim p \wedge \sim q \wedge \sim r$

13. $(p \wedge q) \vee (\sim q \wedge p) \equiv$ **[2009]**

(A) $q \vee p$ (B) p

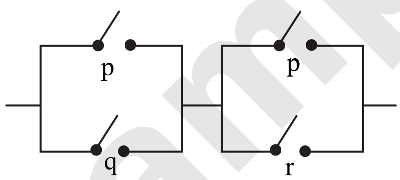
(C) ~q (D) $p \wedge q$

14. Negation of $(\sim p \rightarrow q)$ is **[2009]**

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

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

15. If



then the symbolic form is **[2009]**

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

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

(C) $(p \wedge q) \wedge (p \wedge r)$

(D) $(p \wedge q) \wedge r$

16. If $(p \wedge \sim q) \rightarrow (\sim p \vee r)$ is a false statement, then respective truth values of p, q and r are **[2010]**

(A) T, F, F (B) F, T, T

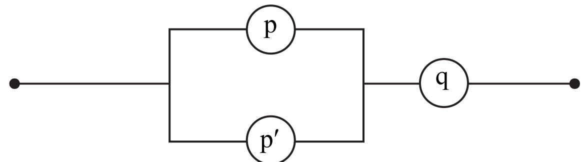
(C) T, T, T (D) F, F, F

17. Negation of the statement $p \rightarrow q$ is **[2010]**

(A) $\sim p \vee q$ (B) $\sim p \vee \sim q$

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

18. Simplified logical expression for the following switching circuit is



[2010]

(A) p (B) q

(C) p′ (D) $p \wedge q$

19. Let p : Boys are playing
q : Boys are happy
the equivalent form of compound statement $\sim p \vee q$ is **[2013]**

(A) Boys are not playing or they are happy.

(B) Boys are not happy or they are playing.

(C) Boys are playing or they are not happy.

(D) Boys are not playing or they are not happy.

20. Let p : A triangle is equilateral, q : A triangle is equiangular, then inverse of $q \rightarrow p$ is **[2013]**

(A) If a triangle is not equilateral then it is not equiangular.

(B) If a triangle is not equiangular then it is not equilateral.

(C) If a triangle is equiangular then it is not equilateral.

(D) If a triangle is equiangular then it is equilateral.

21. If p : Every square is a rectangle
q : Every rhombus is a kite then truth values of $p \rightarrow q$ and $p \leftrightarrow q$ are _______ and _______ respectively. **[2016]**

(A) F, F (B) T, F

(C) F, T (D) T, T

22. Which of the following quantified statement is true ? **[2016]**

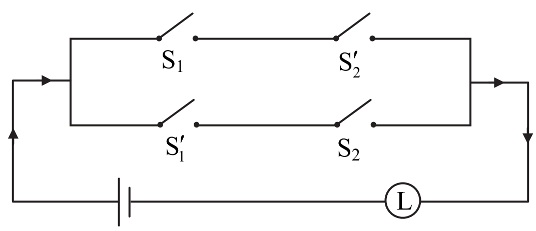
(A) The square of every real number is positive

(B) There exists a real number whose square is negative

(C) There exists a real number whose square is not positive

(D) Every real number is rational

23.



Symbolic form of the given switching circuit is equivalent to ________ **[2016]**

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

(C) $p \leftrightarrow q$ (D) $\sim(p \leftrightarrow q)$

24. The statement pattern $(\sim p \wedge q)$ is logically equivalent to **[2017]**
(A) $(p \vee q) \vee \sim p$ (B) $(p \vee q) \wedge \sim p$
(C) $(p \wedge q) \rightarrow p$ (D) $(p \vee q) \rightarrow p$

25. Which of the following statement pattern is a tautology? **[2017]**
(A) $p \vee (q \rightarrow p)$
(B) $\sim q \rightarrow \sim p$
(C) $(q \rightarrow p) \vee (\sim p \leftrightarrow q)$
(D) $p \wedge \sim p$

26. If c denotes the contradiction then dual of the compound statement $\sim p \wedge (q \vee c)$ is **[2017]**
(A) $\sim p \vee (q \wedge t)$ (B) $\sim p \wedge (q \vee t)$
(C) $p \vee (\sim q \vee t)$ (D) $\sim p \vee (q \wedge c)$

27. The contrapositive of the statement: "If the weather is fine then my friends will come and we go for a picnic." is **[2018]**
(A) The weather is fine but my friends will not come or we do not go for a picnic.
(B) If my friends do not come or we do not go for a picnic then weather will not be fine.
(C) If the weather is not fine then my friends will not come or we do not go for a picnic.
(D) The weather is not fine but my friends will come and we go for a picnic.

28. The statement pattern $p \wedge (\sim p \wedge q)$ is **[2018]**
(A) a tautology
(B) a contradiction
(C) equivalent to $p \wedge q$
(D) equivalent to $p \vee q$

29. The negation of the statement: "Getting above 95% marks is necessary condition for Hema to get admission in good college" is **[2018]**
(A) Hema gets above 95% marks but she does not get admission in good college.
(B) Hema does not get above 95% marks and she gets admission in good college.
(C) If Hema does not get above 95% marks then she will not get admission in good college.
(D) Hema does not get above 95% marks or she gets admission in good college.

30. If p: Rahul is physically disable. q: Rahul stood first in the class, then the statement "In spite of physical disability Rahul stood first in the class in symbolic form is **[2019]**
(A) $p \wedge q$ (B) $p \vee q$
(C) $\sim p \vee q$ (D) $p \rightarrow q$

31. If truth values of p, $p \leftrightarrow r$, $p \leftrightarrow q$ are F, T, F respectively, then respective truth values of q and r are **[2019]**
(A) F, T (B) T, T
(C) F, F (D) T, F

32. The negation of the statement "some equations have real roots" is **[2019]**
(A) All equations do not have real roots
(B) All equations have real roots
(C) Some equations do not have real roots
(D) Some equations have rational roots

33. The equivalent form of the statement $\sim(p \rightarrow \sim q)$ is **[2019]**
(A) $\sim p \vee q$ (B) $p \wedge q$
(C) $p \wedge \sim q$ (D) $p \vee \sim q$

34. The statement pattern
$(p \wedge q) \wedge [\sim r \vee (p \wedge q)] \vee (\sim p \wedge q)$ is equivalent to **[2019]**
(A) r (B) $p \wedge q$
(C) p (D) q

35. Which of the following is NOT equivalent to $p \rightarrow q$. **[2019]**
(A) p is sufficient for q
(B) p only if q
(C) q is necessary for p
(D) q only if p

36. 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. **[2019]**
(A) F, F (B) T, T
(C) T, F (D) F, T

37. $p \leftrightarrow q$ is logically NOT equivalent to **[2019]**
(A) $(\sim p \vee q) \wedge (\sim q \vee p)$
(B) $(p \wedge q) \vee (\sim p \wedge \sim q)$
(C) $(p \wedge \sim q) \vee (q \wedge \sim p)$
(D) $(p \rightarrow q) \wedge (q \rightarrow p)$

38. Let p : I is cloudly, q : It is still raining. The symbolic form of "Even though it is not cloudy, it is still raining" is **[2019]**
(A) $\sim p \wedge q$ (B) $p \wedge \sim q$
(C) $\sim p \wedge \sim q$ (D) $\sim p \vee q$

39. Dual of the statement $(p \rightarrow q) \rightarrow r$ is **[2019]**
(A) $(p \vee \sim q) \vee r$ (B) $(p \rightarrow q) \vee r$
(C) $(q \rightarrow p) \wedge r$ (D) $p \rightarrow (q \rightarrow r)$

40. The contrapositive of "If f(2) = 0, then polynomial f(x) is divisible by (x – 2)" is **[2019]**
(A) If $f(2) \neq 0$ then polynomial f(x) is not divisible by (x – 2)
(B) If polynomial f(x) is not divisible by (x – 2), then $f(2) \neq 0$
(C) If polynomial f(x) is divisible by (x – 2), then f(2) = 0
(D) Polynomial f(x) is divisible by (x – 2) only if $f(2) \neq 0$

41. Let p : $\exists$ n $\in$ N such that n + 5 > 10
q : $\forall$ n $\in$ N, $n^2 + n$ is an even number while $n^2 - n$ is an odd number.
The Truth values of p and q are respectively. **[2019]**

(A) T, F (B) T, T
(C) F, T (D) F, F

42. Which of the following statement pattern is a tautology?
$S_1 \equiv \sim p \rightarrow (q \leftrightarrow p)$,
$S_2 \equiv \sim p \vee \sim q$
$S_3 \equiv (p \rightarrow q) \wedge (q \rightarrow p)$,
$S_4 \equiv (p \rightarrow q) \vee (\sim p \leftrightarrow q)$ **[2020]**

(A) S_2 (B) S_3
(C) S_1 (D) S_4

43. The negation of the statement 'If 5 < 7 and 7 > 2, then 5 > 2' is **[2020]**

(A) 5 < 7 and 7 > 2 or 5 < 2
(B) 5 < 7 and 7 > 2 and 5 > 2
(C) 5 < 7 and 7 > 2 or 5 ≤ 2
(D) 5 < 7 and 7 > 2 and 5 ≤ 2

44. The dual of statement 'Mangoes are delicious but expensive' is **[2020]**

(A) Mangoes are delicious or Mangoes are expensive
(B) Mangoes are delicious or Mangoes are not expensive
(C) mangoes are not delicious and mangoes are not expensive
(D) mangoes are delicious and Mangoes are expensive

45. The negation of the statement pattern $\sim p \vee (q \rightarrow \sim r)$ is **[2020]**

(A) $p \wedge (q \wedge r)$ (B) $p \vee (q \wedge r)$
(C) $\sim p \wedge (q \wedge r)$ (D) $p \rightarrow (q \wedge \sim r)$

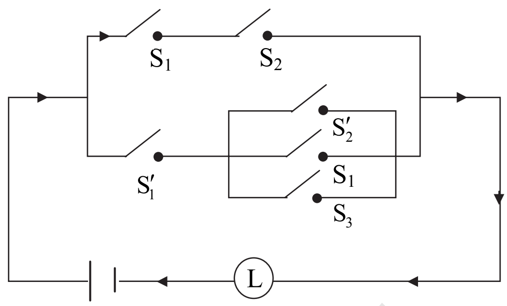
46. If A = {2, 3, 4, 5, 6}, then which of the following statement has truth value 'false' **[2020]**

(A) $\exists\, x \in$ A, such that $x + 2$ is a prime number
(B) $\exists\, x \in$ A, such that $x^2 + 1$ is an even number
(C) $\forall\, x \in$ A, $x + 6$ is divisible by 2
(D) $\exists\, x \in$ A, such that $(x - 2) \in$ N

47. The logical expression
$[p \wedge (q \vee r)] \vee [(\sim p \wedge q) \vee (\sim p \wedge r)]$ is equivalent to **[2020]**

(A) q (B) $p \wedge r$
(C) p (D) $q \vee r$

48. The symbolic from of the following circuit is



(where p, q and r represents switches s_1, s_2 and s_3 which are closed respectively) **[2020]**

(A) $(p \wedge q) \vee \sim p \vee [\sim p \vee p \vee r] \equiv l$
(B) $[(p \vee q) \wedge \sim p] \vee [\sim p \vee q \vee r)] \equiv l$
(C) $(p \wedge q) \vee [\sim p \wedge (\sim q \vee p \vee r)] \equiv l$
(D) $(p \vee q) \wedge [\sim p \vee (\sim q \wedge p \wedge r)] \equiv l$

49. The negation of the statement, $\exists\, x \in$ A such that $x + 5 > 8$ is **[2020]**

(A) $\forall\, x \in$ A such that $x + 5 \leq 8$
(B) $\forall\, x \in$ A such that $x + 5 > 8$
(C) $\exists\, x \in$ A such that $x + 5 < 8$
(D) $\forall\, x \in$ A such that $x + 5 \geq 8$

50. Which of the following statement pattern is a contradiction?
$S_1 \equiv (p \rightarrow q) \wedge (p \wedge \sim q)$
$S_2 \equiv [p \wedge (p \rightarrow q)] \rightarrow q$
$S_3 \equiv (p \vee q) \rightarrow \sim p$
$S_4 \equiv [p \wedge (p \rightarrow q)] \leftrightarrow q$ **[2020]**

(A) S_3 (B) S_4
(C) S_2 (D) S_1

51. The contrapositive of the statement 'If Raju is courageous, then he will join Indian Army', is **[2020]**

(A) If Raju does not join Indian Army, then he is not courageous.
(B) If Raju join Indian Army, then he is not courageous
(C) If Raju join Indian Army, then he is courageous.
(D) If Raju does not join Indian Army, then he is courageous.

52. If the symbolic form of the switching circuit is $[(\sim p \vee (p \wedge \sim q)] \vee q$, then the current flows through the circuit only if **[2020]**

(A) both switches should be closed
(B) irrespective of status of the switches
(C) One switch should be open and other should be closed
(D) both switches should be open

53. The verbal statement of the same meaning, of the statement 'If the grass is green then it rains in July' is **[2020]**
(A) The grass is not green and it does not rains in July.
(B) The grass is not green or it rains in July
(C) The grass is not green if and only if it rains in July
(D) If the grass is not green, then it does not rain in July

54. If p : Seema is fat.
q : She is happy,
then the logical equivalent statement of 'If Seema is fat, then she is happy' is **[2020]**
(A) Seema is fat and she is happy.
(B) Seema is not fat or she is happy
(C) Seema is fat or she is happy
(D) Seema is not fat or she is unhappy

55. The negation of a statement
'$x \in A \cap B \rightarrow (x \in A$ and $x \in B)$' is **[2021]**
(A) $x \in A \cap B \rightarrow (x \in A$ or $x \in B)$
(B) $x \in A \cap B$ and $(x \notin A$ or $x \notin B)$
(C) $x \in A \cap B$ or $(x \in A$ and $x \in B)$
(D) $x \notin A \cap B$ and $(x \in A$ and $x \in B)$

56. p : It rains today
q : I am going to school
r : I will meet may friend
s : I will go to watch a movie.
Then symbolic form of the statement "If it does not rain today or I won't go to school then I will meet my friend and I will go to watch a movie" is **[2021]**
(A) $\sim(p \vee q) \rightarrow (r \vee s)$
(B) $(p \wedge q) \rightarrow (r \vee s)$
(C) $\sim(p \wedge q) \rightarrow (r \wedge s)$
(D) $(\sim p \wedge q) \rightarrow (r \wedge s)$

57. Negation of the satement $\forall x \in R, x^2 + 1 = 0$ is **[2021]**
(A) $\exists x \in R$ such that $x^2 + 1 < 0$.
(B) $\exists x \in R$ such that $x^2 + 1 \leq 0$.
(C) $\exists x \in R$ such that $x^2 + 1 \neq 0$.
(D) $\exists x \in R$ such that $x^2 + 1 = 0$

58. If p, q are true statements and r is false statement, then which of the following is correct? **[2021]**
(A) $(p \vee q) \vee r$ has truth value F.
(B) $(p \wedge q) \rightarrow r$ has truth value T.
(C) $(p \rightarrow r) \rightarrow q$ has truth value F.
(D) $(p \leftrightarrow q) \rightarrow r$ has truth value F.

59. Given p : A man is judge, q : A man is honest
If S_1 : If a man is a judge, then he is honest
S_2 : If a man is a judge, then he is not honest
S_3 : A man is not a judge or he is honest
S_4 : A man is a judge and he is honest
Then **[2021]**
(A) $S_2 \equiv S_3$ (B) $S_1 \equiv S_2$
(C) $S_2 \equiv S_4$ (D) $S_1 \equiv S_3$

60. S_1 : If -7 is an integer, then $\sqrt{-7}$ is a complex number
S_2 : -7 is not an integer or $\sqrt{-7}$ is a complex number
[2021]
(A) S_1 and S_2 are converse statements of each other
(B) S_1 and S_2 are negations of each other
(C) S_1 and S_2 are equivalent statements
(D) S_1 and S_2 are contrapositive of each other

61. "If two triangles are congruent, then their areas are equal." Is the given statement, then the contrapositive of the inverse of the given statement is
(Where p : Two triangles are congruent, q : Their areas are equal)
[2021]
(A) If two triangles are not congruent, then their areas are equal.
(B) If two triangles are not congruent, then their area are not equal.
(C) If areas of two triangles are equal, then they are congruent.
(D) If areas of two triangles are not equal, then they are congruent.

62. The negation of '$\forall x \in N, x^2 + x$ is even number' is **[2021]**
(A) $\forall x \in N, x^2 + x$ is not an even number.
(B) $\forall x \in N, x^2 + x$ is not an odd number.
(C) $\exists x \in N$ such that $x^2 + x$ is an even number.
(D) $\exists x \in N$ such that $x^2 + x$ is not an even number.

63. If p : It is raining.
q : Weather is pleasant
Then simplified form of the statement "It is not true, if it is raining then weather is not pleasant" is
[2021]
(A) It is not raining or weather is pleasant.
(B) It is raining or weather is not pleasant.
(C) It is raining or weather is not pleasant.
(D) It is raining and the weather is pleasant.

64. The negation of the statement 7 is greater than 4 or 6 is less than 7 **[2021]**
(A) 7 is not greater than 4 and 6 is not less than 7
(B) 7 is not greater than 4 or 6 is not less than 7
(C) 7 is greater than 4 and 6 is less than 7
(D) None of the above

65. The contrapositive of the statemnt. 'If $2^2 = 5$, then I get first class' is **[2021]**
(A) If I do not get a first class, then $2^2 = 5$
(B) If I do not get a first class, then $2^2 \neq 5$
(C) If I get a first class, then $2^2 = 5$
(D) None of the above

66. The truth value of the statement 'Patna is in Bihar or 5 + 6 = 111' is **[2021]**
(A) True
(B) False
(C) Cannot say anything
(D) None of these

67. The negation of a statement '$x \in A \cap B \rightarrow (x \in A \text{ and } x \in B)$' is **[2021]**
(A) $x \in A \cap B \rightarrow (x \in A \text{ or } x \in B)$
(B) $x \in A \cap B$ or $(x \in A \text{ and } x \in B)$
(C) $x \in A \cap B$ and $(x \notin A \text{ or } x \notin B)$
(D) $x \notin A \cap B$ and $(x \in A \text{ and } x \in B)$

68. If $(p \wedge \sim r) \rightarrow (\sim p \vee q)$ has truth value 'F', then truth values of p, q and r are respectively. **[2022]**
(A) T, F, F (B) F, F, F
(C) F, F, T (D) T, T, T

69. Consider the statement "P(n) : $n^2 - n + 37$ is prime."
Then, which one of the following is true? **[2022]**
(A) Both P(3) and P(5) are false.
(B) Both P(3) and P(5) are true.
(C) P(3) false, but P(5) is true
(D) P(5) is false, but P(3) is true.

70. Negation of a statement 'If $\forall x$, x is a complex number, then $x^2 < 0$' is **[2022]**
(A) $\exists x$, x is not a complex number and $x^2 \geq 0$
(B) $\forall x$, x is a complex number and $x^2 < 0$.
(C) $\exists x$, x is not a complex number and $x^2 < 0$.
(D) $\forall x$, x is a complex number and $x^2 \geq 0$.

71. The statement pattern
$[p \rightarrow (q \rightarrow p)] \rightarrow [p \rightarrow (p \vee q)]$ is **[2022]**
(A) a contingency
(B) a tautology
(C) a contradiction
(D) equivalent to $p \leftrightarrow q$

72. Which of the following is correct statement?
(a) $S_1 : (p \wedge q) \equiv \sim(p \rightarrow \sim q)$
(b) $S_2 : (p \wedge q) \wedge (\sim p \vee \sim q)$ is tautology.
(c) $S_3 : [p \wedge (p \rightarrow \sim q)] \rightarrow q)$ is contradiction.
(d) $S_4 : p \rightarrow (q \rightarrow p)$ is contingency.
[2022]
(A) statement S_1 is correct.
(B) statement S_4 is correct.
(C) statement S_3 is correct.
(D) statements S_1 and S_2 are correct.

73. If p : 25 is an odd prime number,
q : 14 is a composite number and
r : 64 is a perfect square number.
Then which of the following statement pattern is true? **[2022]**
(A) $\sim(q \wedge r) \vee p$ (B) $\sim p \vee (q \wedge r)$
(C) $(p \wedge q) \wedge r$ (D) $(p \vee q) \wedge (\sim r)$

74. If Statement I : If a quadrilateral ABCD is a square, then all of sides are equal.
Statement II: All the sides of a quadrilateral ABCD are equal, then ABCD is a square. then **[2022]**
(A) Statement II is a negation of statement I.
(B) statement II is an inverse of statement I.
(C) statement II is a converse of statement I.
(D) statement II is a contrapositive of statement I.

75. The negation of the statement
"The payment will be made if and only if the work is finished in time." is **[2022]**
(A) The work is finished in time and the payment is not made.
(B) Either the work is finished in time and the payment is not made or the payment is made and the work is not finished in time.
(C) The payment is made and the work is not finished in time.
(D) The work is finished in time and the payment is not made or the payment is made and the work is finished in time.

76. For three simple statements p, q, and r, $p \rightarrow (q \vee r)$ is logically equivalent to **[2022]**
(A) $(p \vee q) \rightarrow r$
(B) $(p \rightarrow \sim q) \wedge (p \rightarrow r)$
(C) $(p \rightarrow q) \vee (p \rightarrow r)$
(D) $(p \rightarrow q) \wedge (p \rightarrow \sim r)$

77. Which of the following statement pattern is a contradiction? **[2022]**
(A) $S_4 \equiv (\sim p \wedge q) \vee (\sim q)$
(B) $S_2 \equiv (p \rightarrow q) \vee (p \wedge \sim q)$
(C) $S_1 \equiv (\sim p \vee \sim q) \vee (p \vee \sim q)$
(D) $S_3 \equiv (\sim p \wedge q) \wedge (\sim q)$

78. Negation of the statement
"The payment will be made if and only if the work is finished in time." Is **[2023]**
(A) The work is finished in time and the payment is not made.
(B) The payment is made and the work is not finished in time.

(C) The work is finished in time and the payment is not made, or the payment is made and the work is finished in time.

(D) Either the work is finished in time and the payment is not made, or the payment is made and the work is not finished in time.

79. Let p, q, r be three statements, then $[p \rightarrow (q \rightarrow r)] \leftrightarrow [(p \wedge q) \rightarrow r]$ is **[2023]**

(A) equivalent to $p \leftrightarrow q$.
(B) contingency.
(C) tautology.
(D) contradiction.

80. The logical statement $(\sim(\sim p \vee q) \vee (p \wedge r)) \wedge (\sim q \wedge r)$ is equivalent to **[2023]**

(A) $\sim p \vee r$ (B) $(p \wedge \sim q) \vee r$
(C) $(p \wedge r) \wedge \sim q$ (D) $(\sim p \wedge \sim q) \wedge r$

81. If truth value of logical statement $(p \leftrightarrow \sim q) \rightarrow (\sim p \wedge q)$ is false, then the truth values of p and q are respectively **[2023]**

(A) F, T (B) T, T
(C) T, F (D) F, F

82. The inverse of the statement "If the surface area increase, then the pressure decreases.", is **[2023]**

(A) If the surface area does not increase, then the pressure does not decrease.
(B) If the pressure decreases, then the surface area increases.
(C) If the pressure does not decreases, then the surface area does not increase.
(D) If the surface area does not increase, then the pressure decreases.

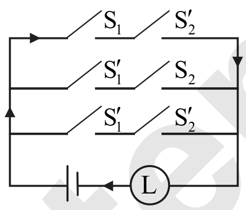
83. The contrapositive of "If *x* and *y* are integers such that *xy* is odd, then both *x* and *y* are odd" is **[2023]**

(A) If both *x* and *y* are odd integers, then *xy* is odd.
(B) If both *x* and *y* are even integers, then *xy* is even.
(C) If *x* or *y* is an odd integer, then *xy* is odd.
(D) If both *x* and *y* are not odd integers, then the product *xy* is not odd.

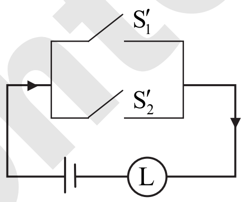
84. Let
Statement 1 : If a quadrilateral is a square, then all of its sides are equal.
Statement 2 : All the sides of a quadrilateral are equal, then it is a square. **[2023]**

(A) Statement 2 is contrapositive of statement 1.
(B) Statement 2 is negation of statement 1.
(C) Statement 2 is inverse of statement 1.
(D) Statement 2 is the converse of statement 1.

85. The given following circuit is equivalent to



[2023]

(A)


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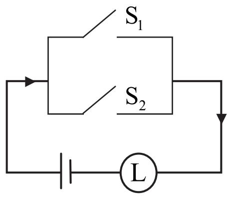

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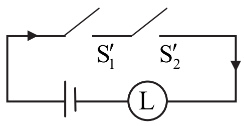

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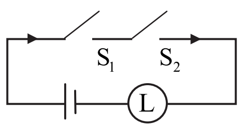


86. If p and q are true statements and r and s are false statements, then the truth values of the statement patterns $(p \wedge q) \vee r$ and $(p \vee s) \leftrightarrow (q \wedge r)$ are respectively **[2023]**

(A) F, T (B) T, T
(C) F, F (D) T, F

87. The negation of the statement pattern $\sim s \vee (\sim r \wedge s)$ is equivalent to **[2023]**

(A) $s \wedge r$ (B) $s \wedge (r \wedge \sim s)$
(C) $s \wedge \sim r$ (D) $s \vee (r \vee \sim s)$

88. Negation of inverse of the following statement pattern $(p \wedge q) \rightarrow (p \vee \sim q)$ is **[2023]**

(A) p (B) ~q
(C) ~p (D) q

89. Negation of contrapositive of statement pattern $(p \vee \sim q) \rightarrow (p \wedge \sim q)$ is **[2023]**
(A) $(\sim p \wedge q) \vee (p \wedge \sim q)$
(B) $(\sim p \vee q) \wedge (p \vee \sim q)$
(C) $(p \wedge \sim q) \vee (\sim p \wedge \sim q)$
(D) $(\sim p \vee \sim q) \wedge (p \vee q)$

90. If q is false and $p \wedge q \leftrightarrow r$ is true, then _______ is a tautology. **[2023]**
(A) $p \vee r$ (B) $(p \wedge r) \rightarrow p \vee r$
(C) $(p \vee r) \rightarrow p \wedge r$ (D) $p \wedge r$

91. The negation of the statement
"The number is an odd number if and only if it is divisible by 3." **[2023]**
(A) The number is an odd number but not divisible by 3 or the number is divisible by 3 but not odd.
(B) The number is not an odd number iff it is not divisible by 3.
(C) The number is not an odd number but it is divisible by 3.
(D) The number is not an odd number or is not divisible by 3 but the number is divisible by 3 or odd.

92. The statement $[(p \rightarrow q) \wedge \sim q] \rightarrow r$ is a tautology, when r is equivalent to **[2023]**
(A) $p \wedge \sim q$ (B) $q \vee p$
(C) $p \wedge q$ (D) $\sim q$

93. If the statement $p \leftrightarrow (q \rightarrow p)$ is false, then true statement/statement pattern is **[2023]**
(A) p (B) $p \rightarrow (p \vee \sim q)$
(C) $p \wedge (\sim p \wedge q)$ (D) $(p \vee \sim q) \rightarrow p$

Evaluation Test

1. Which of the following is not a statement in logic?
(A) Every set is a finite set.
(B) $2 + 3 < 6$
(C) $x + 3 = 10$
(D) Zero is a complex number.

2. If $p \rightarrow (q \vee r)$ is false, then the truth values of p, q and r are respectively
(A) T, F, F (B) F, F, F
(C) F, T, F (D) T, T, F

3. 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

4. The converse of the statement, "If $\sqrt{x}$ is a complex number, then x is a negative number" is
(A) If $\sqrt{x}$ is not a complex number, then x is not a negative number.
(B) If x is a negative number, then $\sqrt{x}$ is a complex number.
(C) If x is not a negative number, then $\sqrt{x}$ is not a complex number.
(D) If $\sqrt{x}$ is a real number, then x is a positive number.

5. 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) $\sim p \wedge q \rightarrow \sim r$

6. The negation of the statement $\forall x \in N, x + 1 > 2$ is
(A) $\forall x \notin N, x + 1 < 2$
(B) $\exists x \in N$, such that $x + 1 > 2$
(C) $\forall x \in N, x + 1 \leq 2$
(D) $\exists x \in N$, such that $x + 1 \leq 2$

7. Which of the following statements is a contingency?
(A) $(\sim p \wedge \sim q) \wedge (q \wedge r)$
(B) $(p \rightarrow q) \vee (q \rightarrow p)$
(C) $(p \wedge \sim q) \rightarrow r$
(D) $(q \rightarrow r) \vee (r \rightarrow p)$

8. 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

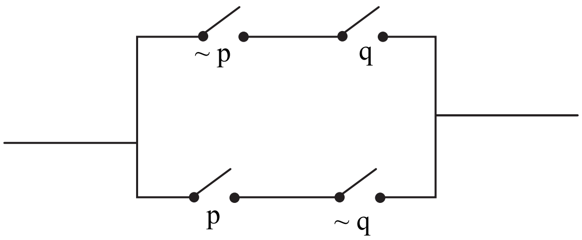
9. If p, q are true and r is a false statement, then which of the following is a true statement?
(A) $(p \wedge q) \vee r$ is F
(B) $(p \wedge q) \rightarrow r$ is T
(C) $(p \vee q) \wedge (p \vee r)$ is T
(D) $(p \rightarrow q) \leftrightarrow (p \rightarrow r)$ is T

10. The dual of the statement
$\sim(p \vee q) \wedge [p \vee \sim (q \wedge \sim r)]$ is
(A) $\sim (p \wedge q) \vee [p \wedge \sim (q \vee \sim r)]$
(B) $(\sim p \wedge \sim q) \vee [\sim p \wedge (\sim q \vee r)]$
(C) $(p \vee q) \wedge [\sim p \vee (q \wedge \sim r)]$
(D) $\sim (p \wedge q) \wedge [\sim p \wedge (q \vee \sim r)]$

11. Consider the following statements:
P : Suman is brilliant
Q : Suman is rich
R: Suman is honest.
The negation of the statement "Suman is brilliant and dishonest iff suman is rich" can be expressed as
(A) $\sim P \wedge (Q \leftrightarrow \sim R)$
(B) $\sim(Q \leftrightarrow (P \wedge \sim R))$
(C) $\sim Q \leftrightarrow \sim (P \wedge R)$
(D) $\sim (P \wedge \sim R) \leftrightarrow Q$

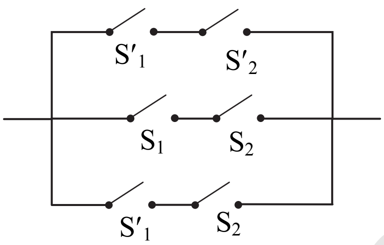
12. Which of the following is true?
(A) $p \wedge \sim p \equiv T$
(B) $p \vee \sim p \equiv F$
(C) $p \rightarrow q \equiv q \rightarrow p$
(D) $p \rightarrow q \equiv (\sim q) \rightarrow (\sim p)$

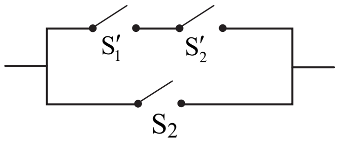
13. The following circuit represent symbolically in logic when the current flow in the circuit.

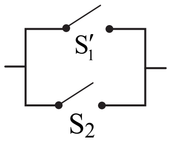


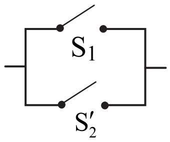
Which of the symbolic form is correct?
(A) $(\sim p \vee q) \vee (p \vee \sim q)$
(B) $(\sim p \wedge p) \wedge (\sim q \wedge q)$
(C) $(\sim p \wedge \sim q) \wedge (q \wedge p)$
(D) $(\sim p \wedge q) \vee (p \wedge \sim q)$

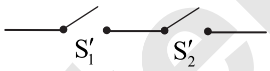
14. Simplified form of the switching circuit given below is



(A) 

(B) 

(C) 

(D) 

15. Statement-1: $\sim(p \leftrightarrow \sim q)$ is equivalent to $p \leftrightarrow q$.
Statement-2: $\sim(p \leftrightarrow \sim q)$ is a tautology.
(A) Statement-1 is true, statement-2 is true.
(B) Statement-1 is true, statement-2 is false.
(C) Statement-1 is false, statement-2 is true.
(D) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for statement-1.

Answer Key of the chapter: *Mathematical Logic* & Evaluation Test is given at the end of the book.

Solutions to the relevant questions of this chapter & Evaluation Test can be accessed by scanning the adjacent QR code in ***Quill - The Padhai App.***

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