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CHAPTER - 14

MATHEMATICAL REASONING

CONCEPT MAP

- A sentence is called a statement if it is either true or false but not both simultaneously.
- The denial of a statement p is called its negation and is written as ~p and read as not p.
- Compound statement is made up of two or more simple statements. These simple statements are called component statements.
- 'And', 'or', 'If–then', 'only if' 'If and only if' etc. are connecting words, which are used to form a compound statement.
- Two simple statements p and q connected by the word 'and' namely 'p and q' is called a conjunction of p and q and is written as $p \wedge q$.
- Compound statement with 'And'
  - ❖ is true if all its component statements are true
  - ❖ false if any of its component statement is false

p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

- Two simple statements p and q connected by the word 'or' the resulting compound statement 'p or q' is called disjunction of p and q and is written as $p \vee q$.

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- Compound statement with 'Or' is
  - ❖ true when at least one component statement is true,
  - ❖ false when both the component statements are false.

p	q	$p \wedge q$
T	T	T
T	F	T
F	T	T
F	F	F

- The negation of the compound statement 'p or q' is '~p and ~q' $\Rightarrow \sim(p \vee q) = \sim p \wedge \sim q$.
- The negation of the compound statement 'p and q' is '~p or ~q' $\Rightarrow \sim(p \wedge q) = \sim p \vee \sim q$.
- A statement with "If p then q" can be rewritten as:-
  - (a) p implies q
  - (b) p is sufficient condition for q
  - (c) q is necessary condition for p
  - (d) p only if q
  - (e) (~q) implies (~p)
- If in a compound statement containing the connective ''or'' all the alternatives cannot occur simultaneously, then the connecting word ''or'' is called as exclusive ''or''.
- If, in a compound statement containing the connective ''or'', all the alternative can occur simultaneously, then the connecting word ''or'' is called as inclusive ''or''.
- Contrapositive of the statement $p \Rightarrow q$ is the statement $\sim q \Rightarrow \sim p$
- Converse of the statement $p \Rightarrow q$ is the statement $q \Rightarrow p$
- "For all", "For every" are called universal quantifiers
- A statement is called valid or invalid according as it is true or false.

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SECTION - A

VERY SHORT ANSWER TYPE QUESTIONS (1 MARK)

1. State whether the following statements are true or false:

   (a) Prime factors of 6 are 2 and 3, represents a Statement.

   (b) Students can take French or Spanish as their third language. The "OR" used in the statement here is "INCLUSIVE OR".

   (c) Two lines intersect at a point or are parallel. The "OR" used in the statement here is "EXCLUSIVE OR".

   (d) The Compound statement "$\sqrt{2}$ is a rational number or an irrational number" is True.

   (e) The Compound Statement "All integers are either even or odd" is False.

2. Fill up blanks in each of the following:

   (a) The negation of the statement "Zero is a positive number" is _____.

   (b) The negation of the statement "For every real number x, either $x > 1$ or $x < 1$." is _____.

   (c) The Converse of the statement "If a number x is even, then x^2 is also even" is _____.

   (d) The Converse of the statement "If n is a prime number, then n is odd." is _____.

   (e) The quantifier used in the statement "There exists a number which is equal to its square" is _____.

   (f) The Contra positive of the statement "If a triangle is equilateral, it is isosceles" is _____.

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Note: Q.3 – Q.7 are Multiple Choice Questions (MCQ), select the correct alternatives out of given four alternatives in each.

3. Which of the following is a statement?
   (a) 2 is not a prime number.
   (b) Mind your own business.
   (c) Be punctual.
   (d) Do not tell lies.

4. The negation of the statement "It is raining and weather is cold." is -
   (a) It is not raining and weather is cold.
   (b) It is raining or weather is not cold.
   (c) It is not raining or weather is not cold.
   (d) It is not raining and weather is not cold.

5. Which of the following is the converse of the statement?
   "If Raju secure good marks, then he will get a Pen."
   (a) If Raju will not get Pen, then he will not secure good marks.
   (b) If Raju will get a Pen, then he will secure good marks.
   (c) If Raju will get a Pen, then he will not secure good marks.
   (d) If Raju will not get a Pen, then he will secure good marks.

6. Which of the following is a mathematical statement?
   (a) n is a real number
   (b) Switch off the light
   (c) 5 is a prime number
   (d) Let's go there.

7. The negation of the statement "A circle is an ellipse" is -
   (a) An ellipse is a circle.
   (b) An ellipse is not a circle.
   (c) A circle is not an ellipse.
   (d) A circle is an ellipse.

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8. Write negation of the statement: "π is not a rational number".

9. Write negation of the statement: "There exists a complex number which is not a real Number"

10. Write the converse of the statement:
"If $3 \times 7 = 21$ then $3 + 7 = 10$"

11. Write the converse of the statement: "If x is zero, then x is neither positive nor negative"

SECTION – B

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

12. Check whether the compound statement is true or false. Write the component statements.
    (a) A square is a quadrilateral and its four sides are equal.
    (b) "0" is either a positive number or negative number.

13. Identify the quantifiers in the following statements:
    (a) For every integer p, $\sqrt{p}$ is a real number.
    (b) There exists a capital for every country in the world.

14. Write the negation of the following compound statements.
    (a) It is daylight and all the people have arisen.
    (b) Square of an integer is positive or negative.

15. Identify the type 'Or' (Inclusive or Exclusive) used in the following statements
    (a) To enter in a country, you need a visa or citizenship card.
    (b) $\sqrt{2}$ is a rational number or an irrational number.

16. Write the contra positive of the following statements:
    (a) If $5 > 7$ then $6 > 7$.
    (b) x is even number implies that x^2 is divisible by 4.

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ANSWERS

1. (a) True (b) False (c) True
   (d) True (e) True

2. (a) Zero is not a positive number.
   (b) There exists a real number x such that $x \leq 1$ and $x \geq 1$.
   (c) If x^2 is even, then x is also even.
   (d) If n is odd then n is Prime number.
   (e) There Exists.
   (f) If triangle is not Isosceles then it is not equilateral.

3. (a) 4. (c) 5. (b)
6. (c) 7. (c)

8. π is a rational number or π is not an irrational number

9. For all complex number x, x is a real number.

10. If 3 + 7 = 10 then 3 × 7 = 21

11. If x is neither positive nor negative then x is zero.

12. (a) True;
    p : A square is a quadrilateral,
    q : All the four sides of a square are equal.
    (b) False;
    p : 0 is a positive number.,
    q : 0 is a negative number

13. (a) For every
    (b) There exists, For every

14. (a) It is not daylight or it is false that all the people have arisen.
    (b) There exists an integer whose square is neither positive nor negative.

15 (a) INCLUSIVE (b) EXCLUSIVE

16. (a) If $6 \leq 7$ then $5 \leq 7$
    (b) If x^2 is not divisible by 4 then x is not even.

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