

CBSE Test Paper 03
CH-14 Mathematical Reasoning

1. The negative of the statement: "Plant take in CO^2 and do not give out O^2 " is
 - a. Plant do not take in CO^2 and do not O^2 .
 - b. plant do not take in and do not give O^2 .
 - c. Plant take in CO^2 do not give out O^2
 - d. Plant take in CO^2 and do not give O^2 .
2. The negation of the compound statement $p \vee (\sim p \vee q)$ is
 - a. $(p \wedge \sim q) \vee p$
 - b. $(p \wedge q) \vee p$
 - c. $(p \wedge \sim q) \wedge \sim p$
 - d. $(p \wedge \sim q) \vee \sim p$
3. Let p be the proposition: Mathematics is interesting and let q be the proposition that Mathematics is difficult, then the symbol $p \wedge q$ means
 - a. Mathematics is interesting implies and is implied by Mathematics is difficult
 - b. Mathematics is interesting and Mathematics is difficult
 - c. Mathematics is interesting implies that Mathematics is difficult
 - d. Mathematics is interesting or Mathematics is difficult
4. The negation of $q \vee \sim (p \wedge r)$ is
 - a. $\sim q \wedge (p \wedge r)$
 - b. $\sim q \wedge (p \vee r)$

c. $q \vee (p \vee r)$

d. $\sim q \vee (p \vee r)$

5. If $p \rightarrow (q \vee r)$ is false, then the truth values of p, q and r, are respectively

a. T,T,T

b. F,F,F

c. F,T,T

d. T,F,F

6. Fill in the blanks:

An assertion that a statement fails or denial of a statement is called the _____ of the statement.

7. Fill in the blanks:

The truth value of the negation of the statement "q: The earth is a star" is _____.

8. Determine the statement is whether an inclusive OR or exclusive OR. Give reasons for your answer.

"A lady gives birth to a baby boy or a baby girl"

9. Check whether the following pair of statements are negations of each other. Give reasons for your answer.

(i) $x + y = y + x$ is true for every real numbers x and y.

(ii) There exists real numbers x and y for which $x + y = y + x$.

10. Determine whether an inclusive OR or exclusive OR is used in the statement. Give reasons for your answer.

"To apply for a driving license, you should have a ration card or a passport"

11. Write the negation of the following statements.

i. A triangle is equilateral if and only if it is equiangular.

ii. Sets A and B are equal if and only if $(A \subseteq B \text{ and } B \subseteq A)$

12. Show that the statement:

p: If x is a real number such that $x^3 + 4x = 0$, then x is 0, is true by direct method.

13. If x and y are positive real numbers, then prove that $x < y \Leftrightarrow x^2 < y^2$.

14. Check whether the statement is true or not:

q: If x, y are integers such that xy is even, then at least one of x and y is an even integer.

15. Which of the following sentences are statements? Give reasons for your answer.

(i) There are 35 days in a month.

(ii) Mathematics is difficult.

(iii) The sum of 5 and 7 is greater than 10.

(iv) The square of a number is an even number.

(v) The sides of a quadrilateral have equal length.

(vi) Answer this question.

(vii) The product of (-1) and 8 is 8.

(viii) The sum of all interior angles of a triangle is 180° .

(ix) Today is a windy day.

(x) All real numbers are complex numbers.

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Solution

1. (a) Plant do not take in CO^2 and do not O^2 .

Explanation: Plant do not take in CO^2 and do not O^2 .

2. (c) $(p \wedge \sim q) \wedge \sim p$

Explanation: $\sim (p \vee (\sim p \vee q)) \equiv \sim p \wedge (p \wedge \sim q)$ Applying De morgan's law

3. (b) Mathematics is interesting and Mathematics is difficult

Explanation: using connective and for $\wedge$

4. (a) $\sim q \wedge (p \wedge r)$

Explanation:

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

5. (d) T,F,F

Explanation:

for $p \rightarrow (q \vee r)$ to be false $p=T$ and $q \vee r \equiv F$ Since T implies F =F.

$q \vee r \equiv F$ implies $q=F$ and $r = F$ since $F \vee F =F$

6. negation

7. True

8. The statement is: "A lady gives birth to a baby boy or a baby girl"

Here, an exclusive "OR" is used because a lady cannot give birth to a baby who is both a boy and a girl.

9. Let p: $x + y = y + x$ is true for every real numbers x and y.

q: There exists real numbers x and y for which $x + y = y + x$.

Now $\sim p$: There exists real numbers x and y for which $x + y \neq y + x$. Thus $\sim p \neq q$.

10. The statement is: "To apply for a driving license, you should have a ration card or a

passport"

An inclusive "OR" is used because a person can have both a ration card and passport to apply for a driving license.

11. i. Let p : A triangle is equilateral.

q : The triangle is equiangular.

Then, the given statement is $p \rightarrow q$.

$\therefore$ The negation of the given statement is

$(p \wedge \sim q) \vee (q \wedge \sim p)$, given by

'There exists either an equilateral triangle which is not equiangular or an equiangular triangle which is not equilateral.'

ii. Let p : Sets A and B are equal.

q : $A \subseteq B$ and $B \subseteq A$.

Then, the given statement is $p \Leftrightarrow q$.

The negation of the given statement is

$(p \wedge \sim q) \vee (q \wedge \sim p)$, given by

'Either $A = B$ and $(A \not\subseteq B$ or $B \subseteq A)$, or $(A \subseteq B$ and $B \subseteq A)$ and $A \neq B$.'

12. Let q and r be the components given by,

q : x is a real number such that $x^3 + 4x = 0$.

r : x is 0.

Direct method: Let q be true.

$\Rightarrow x$ is a real number such that $x^3 + 4x = 0$

$\Rightarrow x(x^2 + 4) = 0$

$\Rightarrow x = 0$ or $x^2 + 4 \neq 0$ [$\because x \in \mathbb{R}$]

$\Rightarrow r$ is true

Hence, p is true.

13. We are given that x and y are real numbers.

Let p : $x < y$

q : $x^2 < y^2$

First, we prove that $p \Rightarrow q$

Let p be true $\Rightarrow x < y$

$\Rightarrow y - x$ is a positive real.

$\Rightarrow (y - x)(y + x)$ is a positive real.

[$\because x, y$ are positive reals. $\therefore x + y$ is also positive and product of two positive]

$\Rightarrow y^2 - x^2$ is a positive real.

$\Rightarrow x^2 < y^2 \Rightarrow q$ is true.

$\therefore p \Rightarrow q$ is true.

Next, we prove that $q \Rightarrow p$

Let q be true, $x < y \Leftrightarrow x^2 < y^2$ is positive real.

$\Rightarrow (y - x)(y + x)$ is positive real.

$\Rightarrow y - x$ is positive real.

$\Rightarrow x < y \Rightarrow p$ is true.

$\therefore q \Rightarrow p$ is true

Combining these two, we find that $(p \Rightarrow q) \vee (q \Rightarrow p)$

i.e., $p \Leftrightarrow q$ is true.

14. Let r and s be two statements given by

r : xy is an even integer.

s : At least one of x and y is an even integer

Let s be not true. Then,

s is not true.

$\Rightarrow$ Both x and y are odd integers

Let $x = 2n + 1$ and $y = 2m + 1$ for some integers n and m . Then,

$\Rightarrow xy = (2n + 1)(2m + 1)$ for some integers n and m .

$\Rightarrow xy = 4nm + 2(n + m) + 1$ for some integers n and m .

$\Rightarrow xy$ is an odd integer.

$\Rightarrow xy$ is not an even integer.

$\Rightarrow \neg r$ is true.

Thus, $\neg s$ is true $\Rightarrow \neg r$ is true.

Hence, the given statement is true.

15. (i) No month has 35 days. Thus the sentence is false declarative sentence. Hence it is a statement.

(ii) Here the correctness of the sentence depends upon the observer. It may be easy for someone and may be difficult for other one. Hence it is not a statement.

(iii) The sentence is true. Hence it is a statement.

(iv) Here the correctness of the sentence depends upon the number that is squared.
Hence it is not a statement.

(v) This sentence is sometimes true and sometimes false. For example side in squares and rhombuses have equal length where as in a rectangles and trapezium, they have unequal length. Hence it is not a statement.

(vi) This sentence is an order. Hence it is not a statement.

(vii) The sentence is true. Hence it is a statement.

(viii) The sentence is true. Hence it is a statement.

(ix) It is not clear from the context which day is referred. Hence it is not a statement.

(x) The sentence is true because all real numbers can be written in the form $a + i \times 0$. Hence it is a statement.