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While we've taken all possible care in the editing, proof reading and printing of this book, still some errors might have crept in.
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FOREWORD

This book is the outcome of the NEW ASSESSMENT POLICY of CBSE recently announced for the session 2021-22 for class XII. The syllabi have been divided into two terms, Term-1 and Term-2. The assessment in Term-1 will be MCQ based, probably in November-December 2021. The assessment will cover all possible types of MCQs like CASE STUDY QUESTIONS, ASSERTION-REASONING MCQs etc. To tackle these Questions the student is required to be conceptually sound and of course practice is the key. Such an assessment tests the Competency of the student in the subject.

To meet this objective, I believe **this book** is one of the best books which will help the student to score highly. This book is written in a **very lucid** and **easy to understand** language and **has a style** of its own.

This book is written to cater to the needs of students for Term-1 Exams.

This book contains **four chapters** which cover the entire first term syllabus in Mathematics.

It starts with **FORMULAE CLUSTER**, which is followed by Multiple Choice Questions from each Chapter and then the Answer Key for all questions. Next comes the **Detailed Solutions** to each question of the concerned chapter. Some questions for Motivation have been given as well (which are deleted otherwise, from the syllabus for 2021-22). These are marked with ☼ and, are meant to enhance conceptual strength. A good number of HOTS (meant for bright students) have been added also.

Then comes the **CBSE CORNER**. Here one finds unit-wise MCQs from CBSE Exam.

It is followed by unit-wise **Case Study Based Questions** which are of two types. Type-1 carries the questions from official Question Bank of CBSE (issued in April, 2021). Type-2 carries the questions prepared by the author.

This book contains a large number of Questions on **ASSERTION-REASONING** with their detailed Solutions. The book also contains **SOURCE-BASED INTEGRATED QUESTIONS**.

To test the preparedness of the students this book contains **Math Warriors Test** for each unit. At the end of the book, a **Revision Test** from the entire first term syllabus has been provided for practice.

I would advise the students to use this book in the following way:

Step-1: Please revise NCERT Textbooks or, MATHEMATICIA Book unit-wise (as per the syllabus of Term 1). This will make the students conceptually strong.

Step-2: Please go through the FORMULA CLUSTER given in this book.

Step-3: Please solve MCQs related to it.

Step-4: Please solve CBSE Questions of the particular unit.

Step-5: Please solve CASE-BASED QUESTIONS (from CBSE Question Bank & Extra Questions).

Step-6: Please take the Math Warrior Tests (the time as mentioned to be strictly followed)

Step-7: Finally take the Revision Test to check your level of preparedness, preferably in the mid-October.

Step-8: Please do not forget to solve the Official Sample Question Paper Of CBSE for the session 2021-22 (Term 1), whenever it is released. To enrich your Practice, Mr O.P. GUPTA will be providing sample papers in the prescribed format as per the Official Sample Question Paper of CBSE.

I wish all the learners for a fantastic mathematical journey with this book by Mr O.P. GUPTA.

Prabhat Marwaha

Vice Principal

Jawahar Navodaya Vidyalaya, Pipersand, Lucknow

A BRIEF SYNOPSIS Of CONTENTS IN

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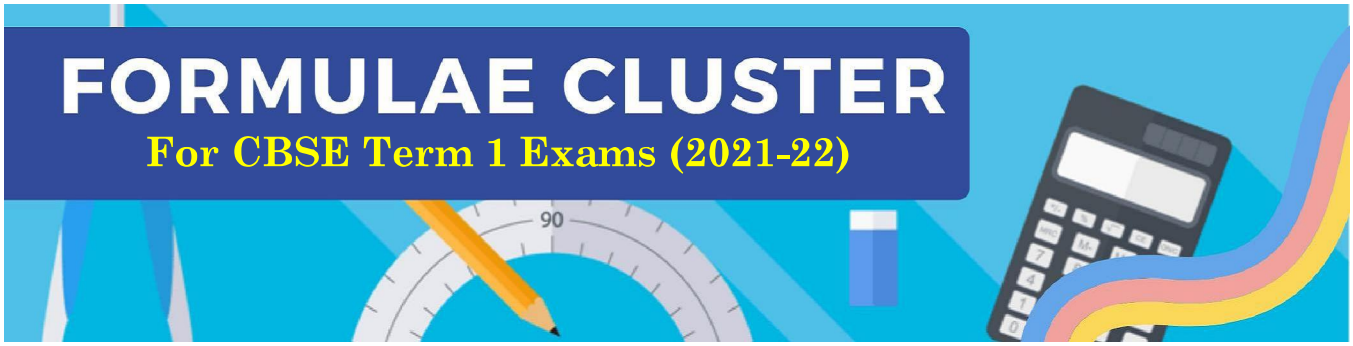


RELATIONS & FUNCTIONS

☑ Relation on a Set & its various types

A relation R from a non-empty set A into itself is called a relation on A. In other words if A is a non-empty set, then a subset of $A \times A = A^2$ is called a relation on A.

NOTE If A be a finite set having *n* elements then, no. of relations on set A is $2^{n \times n}$ i.e. 2^{n^2}.

1) **Empty relation:** A relation R on a set A is said to be empty relation or a void relation if $R = \phi$. In other words, a relation R in a set A is empty relation, if no element of A is related to any element of A, i.e., $R = \phi \subset A \times A$.

2) **Universal relation:** A relation R on a set A is said to be the universal relation on A if $R = A \times A$ i.e., $R = A^2$. In other words, a relation R in a set A is universal relation, if each element of A is related to every element of A, i.e., $R = A \times A$.

NOTE The void relation *i.e.*, ϕ and universal relation *i.e.*, $A \times A$ on A are respectively the *smallest* and *largest* relations defined on the set A. Also these are sometimes called *Trivial Relations*. And, any other relation is called a *non-trivial relation*.

✪ The relations $R = \phi$ and $R = A \times A$ are two *extreme relations*.

3) **Identity relation:** A relation R on a set A is said to be the identity relation on A if $R = \{(a,b) : a \in A, b \in A \text{ and } a = b\}$.

Thus identity relation $R = \{(a,a) : \forall\ a \in A\}$.

The identity relation on set A is also denoted by I_A.

NOTE In an identity relation on A every element of A should be related to itself only.

4) **Reflexive relation:** A relation R on a set A is said to be reflexive if $a\,R\,a\ \forall a \in A$ i.e., $(a,a) \in R\ \forall a \in A$.

NOTE The identity relation is always a reflexive relation but the opposite may or may not be true.

5) **Symmetric relation:** A relation R defined on a set A is symmetric if $(a,b) \in R$ implies $(b,a) \in R\ \forall a,b \in A$ i.e., $a\,R\,b \Rightarrow b\,R\,a$ (i.e., whenever aRb then, bRa).

6) **Transitive relation:** A relation R on a set A is transitive if $(a,b) \in R$ and $(b,c) \in R$ implies $(a,c) \in R$ i.e., $a\,R\,b$ and $b\,R\,c \Rightarrow a\,R\,c$.

7) **Equivalence relation:** Let A be a non-empty set, then a relation R on A is said to be an equivalence relation if
(i) R is reflexive i.e. $(a,a) \in R\ \forall a \in A$.

(ii) R is symmetric i.e. $(a,b) \in R$ implies $(b,a) \in R \ \forall a,b \in A$.

(iii) R is transitive i.e. $(a,b) \in R$ and $(b,c) \in R$ implies $(a,c) \in R$.

✪ **Equivalence classes :** Let R be an equivalence relation in a set A and let $a \in A$. Then, the set of all those elements of A which are related to a, is called equivalence class determined by a and it is denoted by [a]. Thus, $[a] = \{b \in A : (a,b) \in A\}$.

NOTE (i) Two equivalence classes are either disjoint or identical.
(ii) An equivalence relation R on a set A partitions the set into mutually disjoint equivalence classes.

An important property of an equivalence relation is that it divides the set into pair-wise disjoint subsets called **equivalence classes** whose collection is called **a partition of the set**. Note that the union of all equivalence classes gives the whole set.
e.g. Let R denotes the equivalence relation in the set Z of integers given by R = {(a, b) : 2 divides $a-b$}. Then the equivalence class [0] is [0] = $\{0, \pm 2, \pm 4, \pm 6, \ldots\}$.

✪ **No. of Reflexive relations defined on a set of n elements** $= 2^{n(n-1)}$

No. of Symmetric relations defined on a set of n elements $= 2^{\frac{n(n+1)}{2}}$.

No. of Reflexive and Symmetric relations defined on a set of n elements $= 2^{\frac{n(n-1)}{2}}$.

No. of Transitive relations defined on a set having 0, 1, 2, 3 and, 4 elements are 1, 2, 13, 171 and, 3994 respectively.

☑ Function

Defining a Function :
Consider A and B be two non- empty sets then, a rule f which associates **each element of A with a unique element of B** is called a function or the mapping from A to B or f maps A to B. If f is a mapping from A to B then, we write $f : A \to B$ which is read as 'f is a mapping from A to B' or 'f is a function from A to B'.
If f associates $a \in A$ to $b \in B$, then we say that '**b is the image of the element a under the function f**' or '**b is the f-image of a**' or '**the value of f at a**' and denote it by f (a) and we write $b = f(a)$. The element a is called the **pre-image** or **inverse-image of b**.

Thus for a function from A to B,
(i) A and B should be non-empty.
(ii) Each element of A should have image in B.
(iii) No element of A should have more than one image in B.

✪ **Domain, Co-domain & Range of a function :**
Let $f : A \to B$ be a function. Then **set A is called the domain** of the function f and the **set B is called the co-domain**. The set of the images of all the elements of A under the function f is called the **range of the function f** and is denoted as $f(A)$.
Thus range of the function f is $f(A) = \{f(x) : x \in A\}$.
Clearly $f(A) \subseteq B$.

✪ **Types of functions :**

1) **One-one function (Injective function or Injection):** A function $f : A \to B$ is one-one function or injective function if distinct elements of A have distinct images in B.

CHAPTER 03

ALGEBRA OF MATRICES & DETERMINANTS

Select the correct option (s) in the followings.

Q01. If A and B are two matrices such that $A+B$ and AB are both defined then
(a) A and B can be any matrices
(b) A and B are square matrices not necessarily of same order
(c) Number of columns in A = Number of rows in B
(d) A and B are square matrices of same order.

Q02. If $A=\begin{bmatrix}2 & -1\\ 3 & 1\end{bmatrix}$ then, AA^T is equal to

(a) $\begin{bmatrix}5 & 5\\ 10 & 5\end{bmatrix}$ (b) $5\begin{bmatrix}1 & 1\\ 1 & 2\end{bmatrix}$

(c) $5\ I_2$ (d) None of these

Q03. Let $|A|=\begin{vmatrix}a & b & c\\ d & e & f\\ g & h & i\end{vmatrix}=4$ then, $|adj.A|=$

(a) 16 (b) 2 only

(c) –2 only (d) None of these

Q04. If A and B are symmetric matrices of same order, then $AB-BA$ is

(a) null matrix (b) unit matrix

(c) symmetric (d) skew-symmetric

Q05. If a matrix A is such that $3A^3+2A^2+5A+I=O$, then A^{-1} is equal to

(a) $-(3A^2+2A+5I)$ (b) $3A^2+2A+5I$

(c) $3A^2-2A+5I$ (d) None of these

Q06. If $A=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$, then A^4 is

(a) $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ (b) $\begin{bmatrix}1 & 1\\ 0 & 0\end{bmatrix}$

(c) $\begin{bmatrix}0 & 0\\ 1 & 1\end{bmatrix}$ (d) $\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$

Q07. The value of $|A||adjA|$ if $A=\begin{bmatrix}-1 & 0 & 0\\ 0 & -1 & 0\\ 0 & 0 & -1\end{bmatrix}$, is

(a) –2 (b) 1

(c) –1 (d) –3

Q08. If A and B are square matrices of $n\times n$ such that $A^2-B^2=(A-B)(A+B)$, then which of the following is true?

(a) either A or B is a zero matrix (b) $A = B$
(c) $AB = BA$ (d) None of these

Q09. If A is a square matrix of order n, then adj.(adj.A) is equal to
(a) $|A|^n A$ (b) $|A|^{n-1} A$
(c) $|A|^{n-0.2} A$ (d) $|A|^{n-2} A$ [HOTS]

Q10. If A is a singular matrix, then adjA is
(a) singular (b) non-singular
(c) symmetric (d) not defined

Q11. If order of A, B and C are 4×3, 5×4 and 3×7 respectively then, order of $C'(A'\times B')$ is
(a) 7×5 (b) 4×5
(c) 4×3 (d) 5×7

Q12. If $A=\begin{bmatrix} a & 0 & 0 \\ 0 & a & 0 \\ 0 & 0 & a \end{bmatrix}$, then the value of $|\text{adj.A}|$ is
(a) a^{27} (b) a^6
(c) a^9 (d) a^2

Q13. If A is a square matrix such that $A^2 - A + I = O$, then the value of inverse of A is
(a) $A - I$ (b) $I + A$
(c) A (d) $I - A$

Q14. If $A=\frac{1}{3}\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$ is an orthogonal matrix, then
(a) $a=-2, b=-1$ (b) $a=2, b=1$
(c) $a=-2, b=1$ (d) $a=2, b=-1$ [HOTS]

Q15. If $A=\begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix}$ and $|A^3| = 125$, then α is
(a) ±2 (b) ±3
(c) ±1 (d) ±5

Q16. If $A=\begin{bmatrix} a & b \\ b & a \end{bmatrix}$ and $A^2=\begin{bmatrix} \alpha & \beta \\ \beta & \alpha \end{bmatrix}$, then
(a) $\alpha = a^2 + b^2, \beta = 2ab$ (b) $\alpha = a^2 + b^2, \beta = ab$
(c) $\alpha = a^2 + b^2, \beta = a^2 - b^2$ (d) $\alpha = 2ab, \beta = a^2 - b^2$

Q17. The order of $\begin{bmatrix} x & y & z \end{bmatrix}\begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}\begin{bmatrix} m \\ n \\ p \end{bmatrix}$ is
(a) 3×1 (b) 1×1
(c) 1×3 (d) 3×3

🕮 ANSWER KEY

Q01. (d)	**Q02.** (b)	**Q03.** (a)	**Q04.** (d)	**Q05.** (a)	**Q06.** (a)	**Q07.** (c)
Q08. (c)	**Q09.** (d)	**Q10.** (a)	**Q11.** (a)	**Q12.** (b)	**Q13.** (d)	**Q14.** (a)
Q15. (b)	**Q16.** (a)	**Q17.** (b)	**Q18.** (b)	**Q19.** (a)	**Q20.** (c)	**Q21.** (b)
Q22. (b)	**Q23.** (a)	**Q24.** (a)	**Q25.** (c)	**Q26.** (b)	**Q27.** (b)	**Q28.** (c)
Q29. (c)	**Q30.** (b)	**Q31.** (d)	**Q32.** (c)	**Q33.** (d)	**Q34.** (a)	**Q35.** (d)
Q36. (d)	**Q37.** (c)	**Q38.** (b)	**Q39.** (d)	**Q40.** (d)	**Q41.** (a)	**Q42.** (d)
Q43. (a), (d)	**Q44.** (b)	**Q45.** (c)	**Q46.** (b)	**Q47.** (d)	**Q48.** (c)	**Q49.** (b)
Q50. (a)	**Q51.** (a)	**Q52.** (a)	**Q53.** (b)	**Q54.** (a)	**Q55.** (d)	**Q56.** (a)
Q57. (c)	**Q58.** (a)	**Q59.** (c)	**Q60.** (a), (b)	**Q61.** (c)	**Q62.** (b)	**Q63.** (b)
Q64. (c)	**Q65.** (c)	**Q66.** (b)	**Q67.** (d)	**Q68.** (a)	**Q69.** (c)	**Q70.** (c)
Q71. (c)	**Q72.** (d)	**Q73.** (c)	**Q74.** (b)	**Q75.** (c)	**Q76.** (a)	**Q77.** (b)
Q78. (d)	**Q79.** (c)	**Q80.** (b)	**Q81.** (d)	**Q82.** (d)	**Q83.** (c)	**Q84.** (a)
Q85. (b)	**Q86.** (a)	**Q87.** (a)	**Q88.** (d)	**Q89.** (d)	**Q90.** (b)	**Q91.** (d)
Q92. (a)	**Q93.** (b)	**Q94.** (b)	**Q95.** (a)	**Q96.** (a), (b), (c)		**Q97.** (b)
Q98. (a)	**Q99.** (b)	**Q100.** (c)	**Q101.** (b)	**Q102.** (c)	**Q103.** (a)	**Q104.** (b)
Q105. (d)	**Q106.** (c)	**Q107.** (a)	**Q108.** (a)	**Q109.** (b)	**Q110.** (d)	**Q111.** (a)
Q112. (b)	**Q113.** (a)	**Q114.** (b)	**Q115.** (c)	**Q116.** (a)	**Q117.** (d)	**Q118.** (d)
Q119. (b)	**Q120.** (a)	**Q121.** (b)	**Q122.** (d)	**Q123.** (a)	**Q124.** (d)	**Q125.** (c)
Q126. (a)	**Q127.** (d)	**Q128.** (a)	**Q129.** (c)	**Q130.** (d)	**Q131.** (a)	**Q132.** (b)
Q133. (c)	**Q134.** (a)	**Q135.** (b)	**Q136.** (a)	**Q137.** (b)	**Q138.** (c)	**Q139.** (b)
Q140. (a)	**Q141.** (b)	**Q142.** (c)	**Q143.** (d)	**Q144.** (a)	**Q145.** (b)	**Q146.** (c)
Q147. (d)	**Q148.** (d)	**Q149.** (b)	**Q150.** (a)	**Q151.** (a)	**Q152.** (c)	**Q153.** (d)
Q154. (b)	**Q155.** (a)	**Q156.** (c)	**Q157.** (b)	**Q158.** (b)	**Q159.** (c)	**Q160.** (d)
Q161. (b)	**Q162.** (a)	**Q163.** (d)	**Q164.** (a)	**Q165.** (c)		

Answers & Solutions

Q01. Since matrices of same order can be added only. So, A and B must be of some order.
Also AB is defined as well so, the number of columns in A must be same as the number of rows in B.
Clearly from the given options, it can be concluded that (d) is correct.

Q02. Here $AA^T = \begin{bmatrix} 2 & -1 \\ 3 & 1 \end{bmatrix}\begin{bmatrix} 2 & 3 \\ -1 & 1 \end{bmatrix}$

$\Rightarrow AA^T = \begin{bmatrix} 5 & 5 \\ 5 & 10 \end{bmatrix} = 5\begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$.

Q03. As $|\text{adj.A}| = |A|^{n-1}$ where n is order of A so, $|\text{adj.A}| = |A|^{3-1} = (4)^2 = 16$.

Q04. Let $P = AB - BA$

$\Rightarrow P^T = (AB - BA)^T$

$\Rightarrow P^T = (AB)^T - (BA)^T$

$\Rightarrow P^T = B^T A^T - A^T B^T$

As A and B are symmetric matrices i.e., $A = A^T$, $B = B^T$ so, $P^T = BA - AB$

$\Rightarrow P^T = -(AB - BA)$

$\Rightarrow P^T = -P$ so, clearly $P = AB - BA$ is skew-symmetric matrix.

Q05. $3A^3 + 2A^2 + 5A + I = O$

Pre-multiplying both sides by A^{-1}, we get $A^{-1}(3A^3 + 2A^2 + 5A + I) = A^{-1}O$

$\Rightarrow 3A^{-1}AA^2 + 2A^{-1}AA + 5A^{-1}A + A^{-1}I = O$

$\Rightarrow 3IA^2 + 2IA + 5I + A^{-1} = O$

$\Rightarrow A^{-1} = -(3A^2 + 2A + 5I)$.

Q06. $A^2 = AA = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$

So, $A^4 = A^2A^2 = I.I$

$\Rightarrow A^4 = I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

Q07. Note that $A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix} = -I_3$ so, $|A| = |-I_3| = (-1)^3 |I_3| = (-1)^3(1) = -1$

Also, $|A||\text{adj}A| = |A||A|^{3-1} = |A|^3 = (-1)^3 = -1$.

Q08. $A^2 - B^2 = (A - B)(A + B)$

$\Rightarrow A^2 - B^2 = AA + AB - BA - BB$

$\Rightarrow A^2 - B^2 = A^2 + AB - BA - B^2$

$\Rightarrow O = AB - BA$

$\therefore AB = BA$.

CBSE CORNER

CBSE 2020 EXAMS (ANNUAL & COMPARTMENT)

Note that in 2020 Board Exams (Annual & Compartment), there were 20 Objective type questions - including MCQs, Fillers & VSA type. We have **converted** Fillers & VSA type questions into MCQs.

Q01. The corner points of the feasible region determined by the system of linear inequalities are $(0, 0), (4, 0), (2, 4)$ and $(0, 5)$. If the maximum value of $z = ax + by$, where $a, b > 0$ occurs at both $(2, 4)$ and $(4, 0)$, then

(a) $a = 2b$ (b) $2a = b$

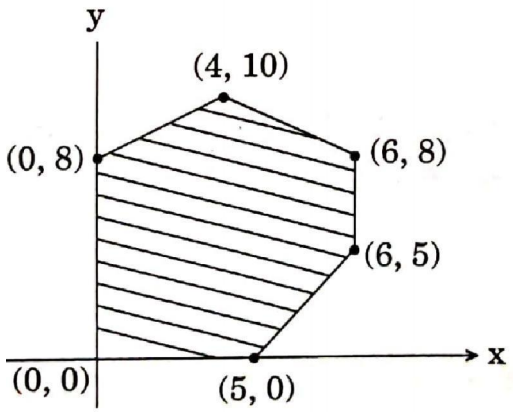
(c) $a = b$ (d) $3a = b$ **[CBSE HMJ/1**

Q02. The corner points of the feasible region of an LPP are (0, 0), (0, 8), (2, 7), (5, 4) and (6, 0). The maximum profit $P = 3x + 2y$ occurs at the point _____.

(a) (0, 8) (b) (2, 7)

(c) (5, 4) (d) (6, 0) **[CBSE HMJ/2**

Q03. The feasible region for an LPP is shown below :



Let $z = 3x - 4y$ be the objective function. Minimum of z occurs at

(a) (0, 0) (b) (0, 8)

(c) (5, 0) (d) (4, 10) **[CBSE HMJ/3**

Q04. In an LPP, if the objective function $z = ax + by$ has the same maximum value on two corner points of the feasible region, then the number of points at which z_{max} occurs is

(a) 0 (b) 2

(c) finite (d) infinite **[CBSE HMJ/4**

Q05. The graph of the inequality $2x + 3y > 6$ is

(a) half plane that contains the origin

(b) half plane that neither contains the origin nor the points of the line $2x + 3y = 6$

(c) whole XOY-plane excluding the points on the line $2x + 3y = 6$

(d) entire XOY-plane **[CBSE HMJ/5**

Q06. The point which doesn't lie in the half plane $2x + 3y - 12 \le 0$ is

(a) (1, 2) (b) (2, 1)
(c) (2, 3) (d) (–3, 2) **[CBSE SQP 2020**

Q07. The objective function of an LPP is
(a) a constant (b) a linear function to be optimized
(c) an inequality (d) a quadratic expression **[CBSE HMJ/C**

Q01. (a) As maximum value of z occurs at (2, 4) and (4, 0) so, $a(2)+b(4)=a(4)+b(0)$
$\Rightarrow a=2b$.

Q02. (c) Note that $P_{(0,0)}=0$, $P_{(0,8)}=16$, $P_{(2,7)}=20$, $P_{(5,4)}=23$, $P_{(6,0)}=18$.
Clearly the maximum profit occurs at (5, 4).

Q03. (b) Minimum of z occurs at (0, 8) i.e., $z_{min}=-32$.

Q04. (d) Suppose same maximum value of z occurs on two corner points A and B. Then, z_{max} will occur at all the points on the line segment joining the points A and B.

Q05. (b) half plane that neither contains the origin nor the points of the line $2x+3y=6$.

Q06. (c) Note that for only (2, 3), we have $2\times2+3\times3-12\le0$ i.e., $1\le0$, which is false.

Q07. (b) a linear function to be optimized.

(Source - CBSE QUESTION BANK)

Unit 1 - Relations & Functions (Case Study Questions)

Q01. A general election of Lok Sabha is a gigantic exercise. About 911 million people were eligible to vote and voter turnout was about 67%, the highest ever.
Let I be the set of all citizens of India who were eligible to exercise their voting right in general election held in 2019. A relation 'R' is defined on I as follows.

ONE - NATION
ONE - ELECTION

FESTIVAL OF DEMOCRACY

GENERAL ELECTION - 2019

$R = \{(V1, V2) : V1, V2 \in I \text{ and both use their voting right in general election - 2019}\}$.

Using the information given above, answer the following :

(i) Two neighbors X and $Y \in I$. X exercised his voting right while Y did not cast her vote in general election - 2019. Which of the following is true?
(a) $(X, Y) \in R$ (b) $(Y, X) \in R$
(c) $(X, X) \notin R$ (d) $(X, Y) \notin R$

(ii) Mr. 'X' and his wife 'W' both exercised their voting right in general election - 2019. Which of the following is true?
(a) both (X, W) and $(W, X) \in R$ (b) $(X, W) \in R$ but $(W, X) \notin R$
(c) both (X, W) but $(W, X) \notin R$ (d) $(W, X) \in R$ but $(X, W) \notin R$

(iii) Three friends F_1, F_2 and F_3 exercised their voting right in general election-2019, then which of the following is true?
(a) $(F_1, F_2) \in R$, $(F_2, F_3) \in R$ and $(F_1, F_3) \in R$
(b) $(F_1, F_2) \in R$, $(F_2, F_3) \in R$ and $(F_1, F_3) \notin R$
(c) $(F_1, F_2) \in R$, $(F_2, F_2) \in R$ and $(F_3, F_3) \notin R$
(d) $(F_1, F_2) \notin R$, $(F_2, F_3) \notin R$ and $(F_1, F_3) \notin R$

(iv) The above defined relation R is _____.
(a) Symmetric and transitive but not reflexive
(b) Universal relation

(c) Equivalence relation
(d) Reflexive but not symmetric and transitive

(v) Mr. Shyam exercised his voting right in General Election - 2019 then, Mr. Shyam is related to which of the following?
(a) All those eligible voters who cast their votes
(b) Family members of Mr. Shyam
(c) All citizens of India
(d) Eligible voters of India

Ans. **(i)** (d) **(ii)** (a) **(iii)** (a) **(iv)** (c) **(v)** (a)

Q02. Sherlin and Danju are playing Ludo at home during Covid-19. While rolling the dice, Sherlin's sister Raji observed and noted the possible outcomes of the throw every time belongs to set {1, 2, 3, 4, 5, 6}. Let A be the set of players while B be the set of all possible outcomes.

Let $A = \{S, D\}$, $B = \{1,2,3,4,5,6\}$.

Using the information given above, answer the following :

(i) Let $R : B \to B$ be defined by $R = \{(x, y) : y \text{ is divisible by } x\}$, is
(a) Reflexive and transitive but not symmetric
(b) Reflexive and symmetric but not transitive
(c) Not reflexive but, symmetric and transitive
(d) Equivalence

(ii) Raji wants to know the number of functions from A to B. How many number of functions are possible?
(a) 6^2 (b) 2^6
(c) 6! (d) 2^{12}

(iii) Let R be a relation on B defined by $R = \{(1,2),(2,2),(1,3),(3,4),(3,1),(4,3),(5,5)\}$.
Then R is
(a) Symmetric (b) Reflexive
(c) Transitive (d) None of these three

(iv) Raji wants to know the number of relations possible from A to B. How many numbers of relations are possible?
(a) 6^2 (b) 2^6
(c) 6! (d) 2^{12}

(v) Let $R : B \to B$ be defined by $R = \{(1,2),(1,2),(2,2),(3,3),(4,4),(5,5),(6,6)\}$, then R is
(a) Symmetric (b) Reflexive and Transitive
(c) Transitive and symmetric (d) Equivalence

Ans. **(i)** (a) **(ii)** (a) **(iii)** (d) **(iv)** (d) **(v)** (b)

CASE STUDY Questions

Referred by CBSE for the Session 2021-22

As per Circular no. Acad-51/2021 (issued on 5 July, 2021)

Unit I - Relations & Functions (Case Study Questions)

Q01. In two different societies, there are some school going students - including girls as well as boys. Satish forms two sets with these students, as his college project.

Let $A = \{a_1, a_2, a_3, a_4, a_5\}$ and $B = \{b_1, b_2, b_3, b_4\}$ where a_i's and b_i's are the school going students of first and second society respectively.

Satish decides to explore these sets for various types of relations and functions.

Using the information given above, answer the following :

(i) Satish wishes to know the number of reflexive relations defined on set A. How many such relations are possible?

(a) 0 (b) 2^5

(c) 2^{10} (d) 2^{20}

(ii) Let $R : A \to A$, $R = \{(x, y) : x \text{ and } y \text{ are students of same sex}\}$. Then relation R is

(a) reflexive only

(b) reflexive and symmetric but not transitive

(c) reflexive and transitive but not symmetric

(d) an equivalence relation

(iii) Satish and his friend Rajat are interested to know the number of symmetric relations defined on both the sets A and B, separately. Satish decides to find the symmetric relation on set A, while Rajat decides to find the symmetric relation on set B. What is difference between their results?

(a) 1024 (b) $2^{10}(15)$

(c) $2^{10}(31)$ (d) $2^{10}(63)$

(iv) Let $R : A \to B$, $R = \{(a_1, b_1), (a_1, b_2), (a_2, b_1), (a_3, b_3), (a_4, b_2), (a_5, b_2)\}$, then R is

(a) neither one-one nor onto (b) one-one but, not onto

(c) only onto, but not one-one (d) not a function

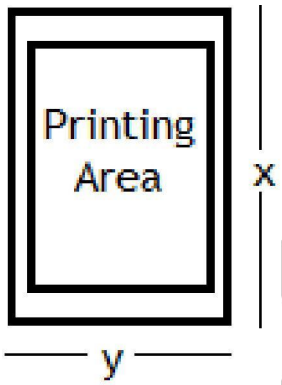
(v) To help Satish in his project, Rajat decides to form onto function from set A to B. How many such functions are possible?

(a) 342 (b) 240

(c) 729 (d) 1024

Q03. There is a local printing press – **Charu Printing Solutions**, whose owner is given a bulk order for printing of a magazine by a school of the same locality. He shows variety of pages to the school administration.

Following is the pictorial description for a particular page, selected by school administration.



The total area of the page is 150 cm^2.

The combined width of the margin at the top and bottom is 3 cm and the side 2 cm.

Using the information given above, answer the following :

(i) The relation between x and y is given by

(a) $(x-3)y=150$ (b) $xy=150$

(c) $x(y-2)=150$ (d) $(x-2)(y-3)=150$

(ii) The area of page where printing can be done, is given by

(a) xy (b) $(x+3)(y+2)$

(c) $(x-3)(y-2)$ (d) $(x-3)(y+2)$

(iii) The area of the printable region of the page, in terms of x, is

(a) $156+2x+\frac{450}{x}$ (b) $156-2x+3\left(\frac{150}{x}\right)$

(c) $156-2x-15\left(\frac{3}{x}\right)$ (d) $156-2x-3\left(\frac{150}{x}\right)$

(iv) For what value of 'x', the printable area of the page is maximum?

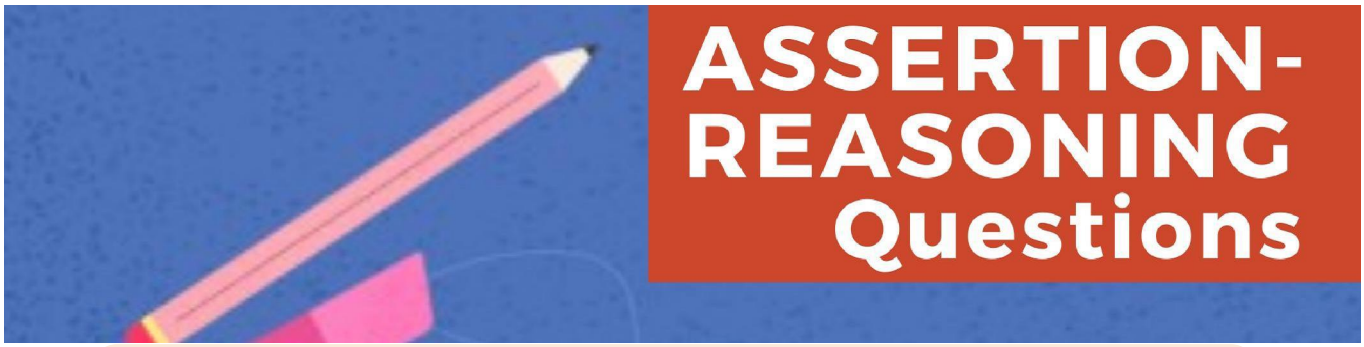
(a) 15 cm (b) 10 cm

(c) 12 cm (d) 15 units

(v) What should be dimension of the page so that it has maximum area to be printed?

(a) Length = 1 cm, width = 15 cm (b) Length = 15 cm, width = 10 cm

(c) Length = 15 cm, width = 12 cm (d) Length = 150 cm, width = 1 cm



Referred by CBSE for the Session 2021-22
As per Circular no. Acad-51/2021 (issued on 5 July, 2021)

Read the following statements carefully to mark the correct option out of the options given below.
(a) Statement 1 is true, statement 2 is true; statement 2 is a correct explanation for statement 1.
(b) Statement 1 is true, statement 2 is true; statement 2 is not a correct explanation for statement 1.
(c) Statement 1 is true, statement 2 is false.
(d) Statement 1 is false, statement 2 is true.

Note that, in place of **Statement 1** and **Statement 2** - we may also write **Assertion** and **Reasoning**, respectively.

Unit 1 (Relations & Functions)
Relations & Functions, Inverse Trig. Functions

Q01. **Statement 1 :** The relation $R = \{(a,b) : a \le b^2\}$ on the set R of real nos. is not reflexive.
Statement 2 : A relation on a set A is reflexive if $(a,a) \in R \ \forall \ a \in A$.

Q02. **Statement 1 :** Let a relation R on the set $\mathbb{R}$ of real numbers be defined as $(a,b) \in R \Leftrightarrow 1+ab > 0 \ \forall a,b \in \mathbb{R}$, is transitive relation.
Statement 2 : A relation on a set A is transitive if (a,b) and $(b,c) \in R$ implies $(a,c) \in R$ for all $a,b,c \in A$.

Q03. **Statement 1 :** If R be the relation defined on Q (set of rational numbers) as $aRb \Leftrightarrow |a-b| \le \frac{1}{2}$, then is not a symmetric relation.
Statement 2 : A relation on a set A is symmetric if $(a,b) \in R$ implies $(b,a) \in R$ for all $a,b \in A$.

Q04. **Statement 1 :** Let T be the set of all triangles in a plane with R being a relation in T given by $R = \{(T_1, T_2) : T_1 \sim T_2\}$. R is an equivalence relation.
Statement 2 : A reflexive, symmetric and transitive relation is an equivalence relation.

Q05. **Statement 1 :** A reflexive relation may or may not be an identity relation.
Statement 2 : A relation R on A is identity relation iff $R = \{(a,b) : a \in A, b \in A \text{ and } a = b\}$.

A total of **100+** Assertion-Reasoning Questions with Solutions are given for Term 1 CBSE Exams of 2021-22, Class 12 Maths (041).

Unit 1 (Relations & Functions)

Relations & Functions, Inverse Trig. Functions

Q01. (a) Note that $\frac{1}{2} > \left(\frac{1}{2}\right)^2 \Rightarrow \left(\frac{1}{2}, \frac{1}{2}\right) \notin R$.

Hence, R is not reflexive.

Q02. (d) Let $a, b, c \in \mathbb{R}$. Let $(a, b) \in R$ and $(b, c) \in R$.

Put $a = 1,\ b = -\frac{1}{2},\ c = -1$.

Note that $\left(1, -\frac{1}{2}\right) \in R$ as $1 + 1\left(-\frac{1}{2}\right) = \frac{1}{2} > 0$.

Similarly, $\left(-\frac{1}{2}, -1\right) \in R$ as $1 + \left(-\frac{1}{2}\right)(-1) = \frac{3}{2} > 0$

But $(1, -1) \notin R$ as $1 + (1)(-1) = 0 > 0$.

Hence, R is not transitive.

Q03. (a) Since $|a - b| \le \frac{1}{2}$ implies, $|-(b - a)| \le \frac{1}{2}$ i.e., $|b - a| \le \frac{1}{2}$.

That is, aRb implies bRa $\forall a, b \in Q$.

Therefore, R is symmetric relation.

Q04. (a) $R = \{(T_1, T_2) : T_1 \sim T_2\},\ R : T \to T$.

Note that R is reflexive, since every triangle is similar to itself, that is $(T_1, T_1) \in R\ \forall\ T_1 \in T$.

Further, $(T_1, T_2) \in R \Rightarrow T_1$ is similar to $T_2 \Rightarrow T_2$ is similar to $T_1 \Rightarrow (T_2, T_1) \in R$.

Hence, R is symmetric.

Moreover, $(T_1, T_2), (T_2, T_3) \in R \Rightarrow T_1$ is similar to T_2 and T_2 is similar to T_3.

$\Rightarrow T_1$ is similar to $T_3 \Rightarrow (T_1, T_3) \in R$.

So R is transitive.

Therefore, R is an equivalence relation.

Q05. (a) A relation R on A is identity relation iff $R = \{(a, b) : a \in A, b \in A \text{ and } a = b\}$ that is, the identity relation R contains only elements of the type $(a, a)\ \forall a \in A$ and it must **not** contain any other element.

While in case of reflexive relation, R must contain $(a, a)\ \forall a \in A$ but it may contain other elements as well.

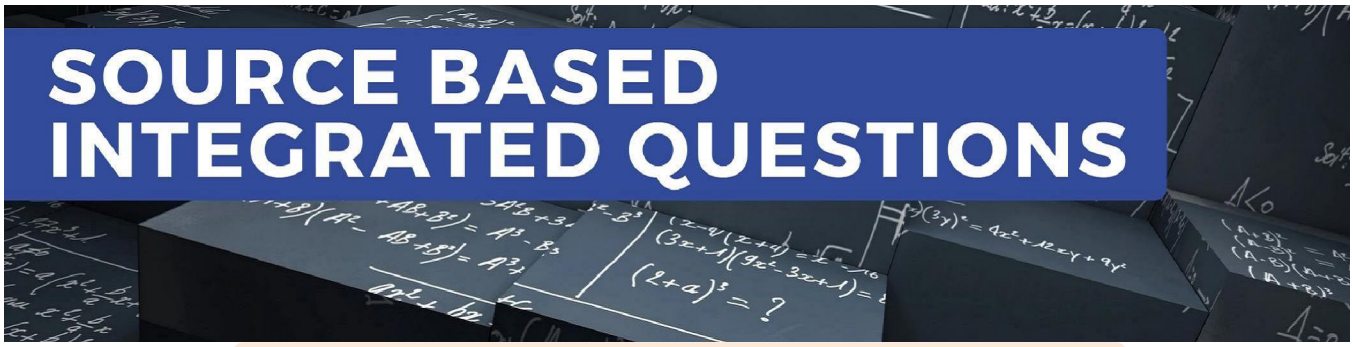
Q06. (d) $f(0 + 1) = 0 + 1 = 1$, and $f(1 + 0) = 1 + 0 = 1$.

As $f(0 + 1) = f(1 + 0)$ but, $(0, 1) \ne (1, 0)$.

Hence, f is not one-one.

Q07. (a) As $f(1) = [1] = 1$ and $f(1.2) = [1.2] = 1$ so, it is clear that $f(1) = f(1.2)$ but $1 \ne 1.2$.

Hence $f(x)$ is not one-one.



SOURCE BASED INTEGRATED QUESTIONS

As per Circular no. 31/2021 (issued on 22 April, 2021)

Q01. We know that $f : R \to [-1,1]$ i.e., $\text{sine} : R \to [-1,1]$ is defined as $f(x) = \sin x$, we have $D_f = R$ and $R_f = [-1,1]$.

Since $f\left(\frac{\pi}{6}\right) = \sin\frac{\pi}{6} = \frac{1}{2}$ and $f\left(\frac{5\pi}{6}\right) = \sin\frac{5\pi}{6} = \frac{1}{2}$ i.e., $f\left(\frac{\pi}{6}\right) = f\left(\frac{5\pi}{6}\right)$ but $\frac{\pi}{6} \neq \frac{5\pi}{6}$ so, clearly $f(x) = \sin x$ is not one-one function. Instead, it is a many-one function.

If we restrict the domain of sine function from set of Real numbers to $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ then it becomes one-one and onto with the range [–1, 1].

Actually, sine function when restricted to any of the intervals $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$, $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$, $\left[-\frac{3\pi}{2}, -\frac{\pi}{2}\right]$ etc., becomes one-one and onto with the range [–1, 1].
We can therefore, define the inverse of sine function in each of these intervals.

Thus, $\sin^{-1}$ is a function with domain [–1, 1] and range could be any of the intervals $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$, $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$, $\left[-\frac{3\pi}{2}, -\frac{\pi}{2}\right]$ etc.

The branch with the range $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ is called the principal value branch, whereas other intervals as range give different branches of $\sin^{-1}$, which are called the non-principal value branch (or, other than principal value branch).

Based on the above information, answer the following :

(i) The domain and range respectively, for the sine function is given as

(a) [–1, 1], R (b) R, [–1, 1]
(c) R, [1, –1] (d) [1, –1], R

(ii) Once we restrict the domain of sine function to $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ then, it becomes

(a) onto only (b) one-one only
(c) one-one and onto both (d) not defined

(iii) From the information given above, if you are asked to write the range of principal value branch of the function $\sin^{-1} x$, then what should be your correct answer?

(a) $\left\{-\frac{\pi}{2}, \frac{\pi}{2}\right\}$ (b) $\left[\frac{\pi}{2}, -\frac{\pi}{2}\right]$

(c) $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$ (d) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

(iv) Which one of the following maybe the non-principal value branch range of $\sin^{-1} x$?

(a) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ (b) $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$

(c) $\left[-\frac{\pi}{2}, -\frac{3\pi}{2}\right]$ (d) $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$

(v) What will be the principal value for $\sin^{-1}\left(-\frac{\sqrt{2}}{2}\right)$?

(a) $-\frac{\pi}{4}$ (b) $\frac{5\pi}{4}$

(c) $\frac{3\pi}{4}$ (d) None of these

Math Warriors Test - 01

Topics covered - Relations & Functions, Inverse Trig. Functions (Class 12)

Time Allowed : 45 Minutes **Max. Marks : 15**

Select the correct option (s) in the followings (Q01-10).
Each question carries 1 Mark.

Q01. $\text{cosec}^{-1}2+\sin^{-1}\left(-\frac{1}{2}\right)$ equals

(a) 0 (b) $\frac{\pi}{3}$

(c) π (d) $\frac{2\pi}{3}$

Q02. $\cos^{-1}\cos 120^{\circ}+\sin^{-1}\sin 120^{\circ}=$

(a) $\frac{\pi}{3}$ (b) $\frac{2\pi}{3}$

(c) π (d) $\frac{\pi}{6}$

Q03. Let $A=\{1,2,3,...,100\}$. Let a relation R be defined on A, given by $R=\{(x,y):xy \text{ is a perfect square}\}$. Then the **equivalence class** [3] is given by

(a) $\{3,12,2748,75\}$ (b) $\{3,12,27,75\}$

(c) $\{12,27,48,75\}$ (d) $\{3,12,27,48,75\}$

Q04. If $f(y)=\log y$, then the value of $f(y)+f\left(\frac{1}{y}\right)$ is

(a) 1 (b) 2

(c) $\frac{1}{8}$ (d) 0

Q05. Let L be the set of all lines in a plane and R be the relation in L defined as $R=\{(L_1,L_2):L_1 \text{ is perpendicular to } L_2\}$ then, which one of the following is correct?

(a) R is reflexive and symmetric but not transitive
(b) R is an equivalence relation
(c) R is symmetric but neither reflexive nor transitive
(d) None of these

Q06. The number of onto function from A to B, if A = {1, 2, 3, 4} and, B = (5, 6, 7, 8, 9}, is

(a) 1024 (b) 625

(c) 0 (d) data incorrect

Q07. Value of $\frac{3\pi}{4}-\sin^{-1}\left(-\frac{1}{\sqrt{2}}\right)$ is

(a) $-\frac{\pi}{4}$ (b) $\frac{\pi}{2}$

(c) $\frac{\pi}{4}$ (d) π

Q08. For real numbers x and y, a relation R is defined as $xRy \Leftrightarrow x-y+\sqrt{3}\in T$, where T is the set of irrational number. Then, R is

(a) transitive (b) reflexive
(c) symmetric (d) equivalence

Q09. Domain of $\sec^{-1} x$ is

(a) $R-(-1,1)$ (b) $R-[-1,1]$
(c) R (d) $(0, \infty)$

Q10. Range of $2\sin^{-1} x$ is

(a) $[-1, 1]$ (b) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$
(c) $[-\pi, \pi]$ (d) $[-2, 2]$

✪ Read the following statements carefully to mark the correct option out of the options given below.
(a) Statement 1 is true, statement 2 is true; statement 2 is a correct explanation for statement 1.
(b) Statement 1 is true, statement 2 is true; statement 2 is not a correct explanation for statement 1.
(c) Statement 1 is true, statement 2 is false.
(d) Statement 1 is false, statement 2 is true.

Q11. **Statement 1 :** Number of symmetric relations defined on $\{2\}$ is 2.
Statement 2 : If a function f(x) is onto then, its Range and codomain must be same.

Following is a **Case Study type Question**, which carries five sub-parts; you need to attempt any four sub-parts.

Q12. A general election of Lok Sabha is a gigantic exercise. About 911 million people were eligible to vote and voter turnout was about 67%, the highest ever.
Let I be the set of all citizens of India who were eligible to exercise their voting right in general election held in 2019. A relation 'R' is defined on I as follows.

ONE - NATION
ONE - ELECTION

FESTIVAL OF DEMOCRACY

GENERAL ELECTION - 2019

$R = \{(V_1, V_2) : V_1, V_2 \in I$ and both use their voting right in general election - 2019$\}$.

Using the information given above, answer the following :

(i) Two friends X and $Y \in I$. X and Y both exercised their voting right in the general election - 2019. Which of the following is true?
(a) $(X, Y) \in R$
(b) $(Y, Y) \notin R$
(c) $(X, X) \notin R$
(d) $(X, Y) \notin R$

(ii) Mr. 'X' and his wife 'W' both exercised their voting right in general election - 2019. Which of the following is true?

(a) both (X, W) and (W, X) $\in$ R

(b) (X, W) $\in$ R but (W, X) $\notin$ R

(c) both (X, W) but (W, X) $\notin$ R

(d) (W, X) $\in$ R but (X, W) $\notin$ R

(iii) Three brothers B_1, B_2 and B_3 exercised their voting right in general election-2019, then which of the following is true?

(a) $(B_1, B_2) \in R$, $(B_2, B_3) \in R$ and $(B_1, B_3) \in R$

(b) $(B_1, B_2) \in R$, $(B_2, B_3) \in R$ and $(B_1, B_3) \notin R$

(c) $(B_1, B_2) \in R$, $(B_2, B_2) \in R$ and $(B_3, B_3) \notin R$

(d) $(B_1, B_2) \notin R$, $(B_2, B_3) \notin R$ and $(B_1, B_3) \notin R$

(iv) Mr. Ghanshyam exercised his voting right in General Election - 2019 then, he is related to which of the following?

(a) All those eligible voters who cast their votes

(b) Family members of Mr. Ghanshyam

(c) All citizens of India

(d) Eligible voters of India

(v) The above defined relation R is _____

(a) Symmetric and transitive but not reflexive

(b) Universal relation

(c) Equivalence relation

(d) Reflexive but not symmetric and transitive

🕮 ANSWER KEY

(Answer Key has been given in the Book)

Other resources for helping you in your Preparation

📖 **Subjective Tests for 12th** (CRT Tests, Topic-wise) : These will help you in developing your concepts, as you will be writing all the steps.

📖 **MCQ Tests for 12th** (With Case Study Qs, Assertion-Reasoning Qs etc.) : These will help you in having **good practice for Term 1** Examination.

📖 **Full Syllabus Tests** (PTS for Term 1 & later on PTS for Term 2) : Full syllabus tests must be written after mid-October. These tests will help you in time management and will familiarize you with the pattern of CBSE Board Question Paper. It is for this purpose, our Full Syllabus Tests are strictly based on the Official Sample Question Paper of CBSE.

We will roll-out the Full Syllabus Tests after CBSE issues its official sample paper.

📖 If CBSE decides to conduct **Term-2 Exams** also in MCQ format due to pandemic situation, **we shall roll-out the MCQ Book for the Term-2** as well, immediately.

📖 You may grab our other Class 12, Best seller Books like

- ✪ **MATHEMATICIA Of 12th With SOLUTIONS**: A Refresher book for XII CBSE aspirants and JEE Main, NDA aspirants.
- ✪ **NCERT Exemplar Problems** in Mathematics Solutions.

📖 Besides that, many **Assignment practice sheets** are made and shared for helping out the students in their preparation.

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