Class XI

Mathematics

Chapter:2 Relations and Functions

Points to Remember

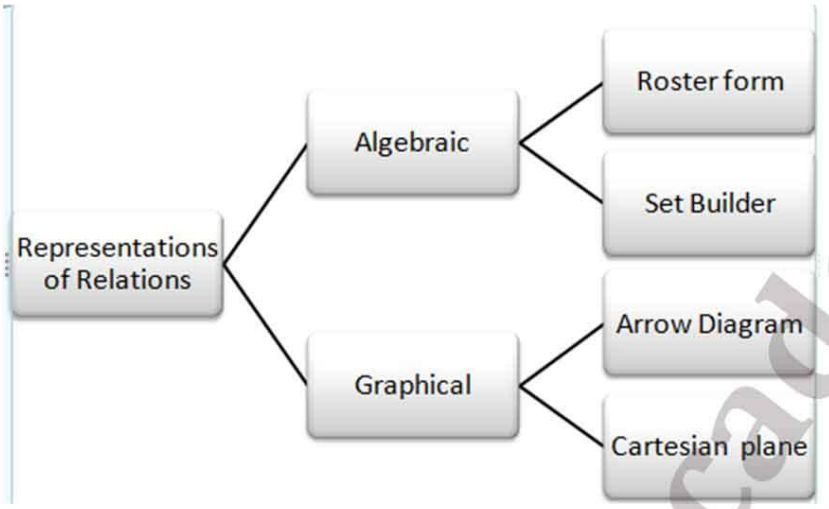
Key Concepts

1. A pair of elements grouped together in a particular order is known as an ordered pair.
2. The two ordered pairs (a, b) and (c, d) are said to be equal if and only if a = c and b = d.
3. Let A and B be any two non empty sets. The Cartesian product A × B is the set of all ordered pairs of elements of sets from A and B defined as follows: A × B = {(a, b) : a ∈A, b ∈B}.

   Cartesian product of two sets is also known as Product Set.
4. If any of the sets of A or B or both are empty then the set A × B will also be empty and consequently, n(A × B) =0
5. If the number of elements in A is m and the number of elements in set B is n then the set A × B will have mn elements
6. If any of the sets A or B is infinite, then A × B is also an infinite set.
7. Cartesian product of sets can be extended to three or more sets If A, B and C are three non empty sets, then A × B × C = {(a, b, c): a ∈A, b∈B, c∈C}.Here (a, b, c) is known as an ordered triplet.
8. Cartesian product of a non empty set A with an empty set is empty set i.e A X Φ = Φ

9. The Cartesian product is not commutative, namely A x B is not the same as B x A, unless A and B are equal.
10. Cartesian product is associative, namely A x (B x C)=(A x B) x C
11. $R \times R = \{(a, b) : a \in R, b \in R\}$ represents the coordinates of all points in two dimensional plane. $R \times R \times R = \{(a, b, c): a \in R, b \in R, c \in C\}$ represents the coordinates of all points in three dimensional plane.
12. A relation R from the non empty set A to another non empty set B is a subset of their Cartesian product $A \times B$, i.e $R \subseteq A \times B$.
13. If $(x, y) \in R$ or x R y then x is related to y and $(x, y) \notin R$ or x $\not{R}$ y then x is not related to y.
14. The second element b in the ordered pair (a,b) is the image of first element a and a is the pre-image of b.
15. The **Domain** of R is the set of all first elements of the ordered pairs in a relation R. In other words domain is the set of all the inputs of the relation.
16. If the relation R is from a non empty set A to non empty set B then set B is called the **co - domain** of relation R.
17. The set of all the images or the second element in the ordered pair (a,b) of relation R is called the **Range** of R.
18. The total number of relations that can be defined from a set A to a set B is the number is possible subsets of A X B.
19. $A \times B$ can have 2^{mn} subsets. This means there are 2^{mn} relations from A to B

20. Relation can be represented algebraically and graphically. The various methods are as follows:



21. A relation f from a non –empty set A to another non- empty set B is said to be a function if every element of A has a unique image in B.

22. The domain of f is the set A. No two distinct ordered pairs in f have the same first element.

23. Every function is a relation but converse is not true

24. If f is a function from A to B and (a, b) $\in$ f, then f (a) = b, where b is called **image** of a under f and a is called the **pre-image** of b under f

25. If f: A $\rightarrow$ B A is the domain and B is the co domain of f.

26. The Range of the function is the set of images.

27. A real function has the set of real numbers or one of its subsets both as its domain and as its range.

28. **Identity function**: f: X $\rightarrow$ X is an identity function if f(x) = x for each x $\in$ A

29. Graph of the identity function is a straight line that makes an angle of 45° with both x and y axes. All points on this line have their x and y coordinates equal.

30. **Constant function**: A constant function is one that maps each element of the domain to a constant. Domain of this function is R and range is the singleton set {c} where c is a constant.

31.. Graph of constant function is a line parallel to the x axis. The graph lies above x axis if the constant $c > 0$, below the x axis if the constant $c < 0$ and is same as x axis if $c = 0$

32. **Polynomial function**: f: $R \to R$ defined as $y = f(x) = a_0 + a_1x + a_2x^2 + \ldots + a_n x^n$ where n is a non-negative integer and $a_0, a_1, a_2, \ldots a_n \in R$.

33. A linear polynomial represents a straight line, a quadratic polynomial represents a parabola.

34. Functions of the form $\frac{f(x)}{g(x)}$, where f(x) and $g(x) \neq 0$ are polynomial functions are called rational functions.

35. Domain of rational functions does not include those points where g(x) = 0. For example domain of $f(x)=\frac{1}{x-2}$ is R-{2}.

36. **Modulus function**: f: $R \to R$ defined by $f(x) = |x|$ for each $x \in R$ $f(x) = x$ if $x \geq 0$ $f(x) = -x$ if $x < 0$ is called modulus or absolute value function. The graph of modulus function is above the x axis.

37.. **Step or greatest integer function**: A function f: $R \to R$ defined by $f(x) = [x]$, $x \in R$ where [x] is the value of greatest integer, less than or equal to x is called a step or greatest integer function.

38. Signum function: $f(x)=\frac{|x|}{x}, x \neq 0$ and 0 for x=0. The domain of signum function is R and range is {-1,0,1}.

Key Formulae

1. **R X R** = { (x, y): x, y ∈ **R**}

   and **R X R x R** = (x, y, z): x, y, z ∈ **R**}
2. If (a, b) =(x, y), then a = x and b = y.
3. (a, b, c) = (d, e, f) if a = d, b = e , c = f
4. If n (A) = n and n (B) = m, then n (A X B) = mn
5. If n (A) = n and n (B) = m, then 2^{mn} relations can be defined from A to B
6. **Algebra of Real function** For function f : X → R and g: X → R , we have

   (f + g) (x) = f (x) + g (x), x ∈ X

   (f – g) (x) = f (x) – g (x), x ∈ X

   (f.g) (x) = f (x). g (x), x ∈ X

   (kf) (x) = kf (x) x ∈ X, where k is a real number.

   $\left(\frac{f}{g}\right)(x)=\frac{f(x)}{g(x)}, x \in X, g(x) \neq 0$