ANALYSIS OF TWO SETS

Equal Sets

Equal sets in set theory are sets where the number of elements is the same, and all the elements are identical. This concept pertains to the equality of sets. Before delving into the specifics of equal sets, it's essential to revisit the meaning of sets. A set is a clearly defined collection of objects, such as letters, numbers, people, shapes, etc., typically represented by a capital letter and braces '{}'.
Set theory encompasses the study of various types of sets. This article focuses on exploring the concept of equal sets, providing their definition and properties. Additionally, we will examine the distinctions between equal sets and equivalent sets, illustrated through examples to enhance comprehension.

What Are Equal Sets?

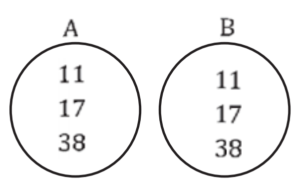
Equal sets are characterized by having the same cardinality and identical elements. In simpler terms, two or more sets are considered equal if they share the same elements and the same quantity of elements. For instance, consider set
$A = \{1, 2, 3, 4, 5\}$ and $B = \{1, 2, 3, 4, 5\}$. In this case, sets A and B are deemed equal since their elements match, and they possess the same cardinality.
Conversely, sets are considered unequal if their elements are not identical, and sets sharing the same number of elements are termed equivalent sets. For example, if
$A = \{1, 2, 3, 4, 5\}$, $C = \{2, 4, 6, 7, 9\}$, and $D = \{2, 5, 6\}$, sets A and C are equivalent as they share the same number of elements, although not identical. On the other hand, sets A and D are unequal as they neither have the same cardinality nor identical elements. The concepts of equal and equivalent sets can be grasped by considering the number and similarity of elements in the two sets.

Equal Sets Definition

If the elements of two or more sets are identical, and the number of elements is also the same, these sets are considered equal sets.
The symbol '=' is used to represent equal sets; for instance, if sets A and B are equal, it is denoted as
$A = B$. Importantly, the order of elements within sets does not affect their equality. Therefore, if
$A = \{a, b, c, d\}$ and $B = \{b, a, d, c\}$, A and B are deemed equal sets because they share the same elements, and the order of elements does not impact the equality of the sets.

Equal Sets Representation Using Venn Diagram.

Now, let's depict equal sets on a Venn diagram. The following Venn diagram illustrates two sets, A and B, which are equal, possessing the same number of elements and identical elements.
i.e., $A = \{11, 17, 38\} = B$.



Properties Of Equal Sets

Now that we've grasped the concept of equal sets, our next focus will be on examining some crucial properties that aid in the recognition and comprehension of these sets:

- The sequence of elements has no bearing on the equality of two sets.
- Equal sets exhibit identical cardinality, signifying an equal count of elements.
- In instances where two sets are mutually subsets of each other, the set notation employed is $A \subseteq B$ and $B \subseteq A$, and this implies equality: $A = B$.
- For sets to be considered equal, all elements must be identical.

- The power set of equal sets shares the same cardinal number.
- Equal and equivalent sets share the common attribute of possessing an equal number of elements.
- While all equal sets are also equivalent sets, the reverse is not necessarily true.

Difference Between Equal And Equivalent Sets

The provided table outlines the resemblances and distinctions between equal and equivalent sets:

Equal Sets	Equivalent Sets
If the elements in two or more sets are identical, the sets are considered equal.	If the count of elements is identical in two or more sets, then they are considered equivalent.
Sets that are equal share identical cardinality.	Sets that are equivalent share identical cardinality.
They possess an equal count of elements.	They possess an equal count of elements.
The symbol '=' is employed to represent equal sets.	The symbols ~ or ≡ are utilized to represent equivalent sets.
All equal sets are equivalent sets.	Equivalent sets can be either equal or not equal.
Elements should be the same.	Elements are not required to be identical.
If the elements in two or more sets are identical, the sets are considered equal.	If the count of elements is identical in two or more sets, then they are considered equivalent.
Sets that are equal share identical cardinality.	Sets that are equivalent share identical cardinality.

Important Properties Of Equal Sets

- Equal sets are synonymous, but sets that are equivalent may not necessarily be equal.
- Sets sharing identical elements are considered equal.
- If two sets are subsets of one another, they are regarded as equal.

A set is a clearly defined collection of numbers, objects, alphabets, or any items presented within curly brackets, while a subset is a portion of that set. The elements of sets can encompass various entities such as real numbers, integers, variables, natural numbers, constants, whole numbers, etc. This article will delve into subsets, covering their definition, subset symbols, types, examples, and more. Additionally, it will provide insights into sets, subsets, and supersets, highlighting their distinctions for better comprehension. As an example, if set P comprises odd numbers and set Q includes {1,5,7}, then Q is considered a subset of P, denoted by the symbol $Q \leq P$, where P serves as the superset of Q. To gain a comprehensive understanding, let's first explore sets and their diverse categories.

SUBSET

A subset is a smaller group of elements derived from a larger set. In the context of two sets, A and B, A is deemed a subset of B if every element in A is also present in B. Alternatively, we can express this by saying that A is contained within B.

To illustrate the concept of subsets more clearly, consider a set P containing the names of all cities in a country. Now, envision another set, Q, comprising the names of cities in your specific region. In this scenario, Q is considered a subset of P, as all the cities in your region are inherently part of the broader set of all cities in the country; hence, Q is a subset of P. It's important to note that for any given set, there is a finite number of distinct and unique subsets, rendering any additional subsets irrelevant and redundant.

Example:

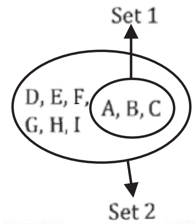
In our understanding, a subset is a set that exists within another set, similar to selecting ice cream flavors from the options: {mango, chocolate, butterscotch}.

- You have the option to choose any single flavor: {mango}, {chocolate}, or {butterscotch},
- Alternatively, you can opt for any combination of two flavors: {mango, chocolate}, {chocolate, butterscotch}, or {mango, butterscotch}.

Subset Meaning In Math's.

Set 1 is considered a subset of Set 2 when all the elements of Set 1 are present in Set 2. In simpler terms, Set 1 is encompassed within Set 2.

For instance, if Set 1 = {A, B, C} and Set 2 = {A, B, C, D, E, F, G, H, I}, it can be affirmed that Set 1 is a subset of Set 2, given that all the elements in Set 1 are included in Set 2.



Set 1 is a subset of Set 2

Subset Symbol

In set theory, the concept of a subset is denoted by the symbol ⊆ and is referred to as 'is a subset of.' Using this symbol, we can represent subsets as follows: $P \subseteq Q$; which is read as Set P is a subset of Set Q.

> A subset has the possibility of being identical to the set; in other words, a subset can include all the elements present in the set.

Ex. Determine whether P is a subset of Q?

P = {set of even digits), Q = {set of whole numbers}

Sol. The collection of even numbers can be expressed as:

$$P = \{0, 2, 4, 6, 8, 10, 12 ...\}$$

Likewise, the set comprising all whole numbers can be depicted as:

$$Q = \{0, 1, 2, 3, 4, 5, 6, 7...\}$$

By examining the elements of sets P and Q, it becomes evident that the elements of P are contained within set Q. Hence, P is a subset of Q.

Ex. Verify if P is a subset of Q.

P = {1, 3, 5, and 7}, Q= {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14....}

Sol. Analyzing the elements of the sets reveals a connection between the elements of P and set Q. Therefore, P is a subset of Q.

Ex. Determine if X is a subset of Y.

X = {All writing material in a stationary workshop}, Y = {Pencils}

Sol. Set X includes items like pens, sketch pens, markers, pencils, notepads, etc. In contrast, set Y only consists of pencils. We cannot assert that all elements of X are present in Y, which is a condition for X to be a subset of Y. In this specific instance, we can affirm that Y is a subset of X, but X is not a subset of Y.

Ex. Check if A is a subset of B.

A = {Toyota), B = {All brands of cars}

Sol. Set B encompasses various car brands such as Maruti Suzuki, Hyundai, Toyota, Mahindra, Tata Motors, Mercedes Benz, etc. Additionally, A is specifically a set of Toyota. Therefore, we can affirm that all elements of A are included in B. Consequently, A is a subset of B.

All Subsets Of A Set

The number of subsets in a set encompasses all possible sets, including its individual elements and the null set. Let's explore this concept with an example.

Ex. Determine all the subsets of set P = {2, 4, 6, 8}

Sol. Given, P = {2, 4, 6, 8}

Number of subsets of P are

- {}
- {2}, {4}, {6}, {8},
- {2,4}, {2,6}, {2, 8}, {4,6}, {4, 8}, {6, 8),
- {2, 4, 6}, {4, 6, 8}, {2, 6, 8), (2, 4, 8}
- {2, 4, 6, 8)

Types Of Subsets

Subsets are primarily divided into:

- Proper Subsets
- Improper Subsets

Proper Subset

A set, denoted as "P," is considered a proper subset of Q if there exists at least one element in Q that is not present in set P. In simpler terms, a proper subset is characterized by containing some elements of the original set.

Alternatively, if P and Q are distinct sets and all elements of P are found in Q, then P is identified as the proper subset of Q. This relationship is also referred to as a strict subset.

Proper Subset Examples

Ex. Is P a proper subset of Q where P = {1, 3, 7, 8) and Q = {1, 3, 7, 8}?

Sol. No, P is not a proper subset of Q because they are identical, and Q lacks any distinct elements not present in P.

Ex. Does X constitute a proper subset of Y, given that X is {1, 6} and Y is {1, 4, 6, 8}?

Sol. Certainly, X qualifies as a proper subset of Y since all elements of X are found in Y, and X is distinct from Y.

Proper Subset Symbol

A proper subset is denoted by the symbol ⊂ and is described as 'is a proper subset of.' **For instance,** P ⊂ Q.

Improper Subset

Consider two sets, X and Y. X is considered an improper subset of Y when it encompasses all the elements of Y. This means that an improper subset contains every element of the original set along with the null set. The symbol for an improper subset is ⊆. **For instance**, P ⊆ Q.

Ex. If the set P is {2, 3, 5}, ascertain the count of subsets, proper subsets, and improper subsets.

Sol. Number of subsets: (2), (3), (5), (2,3), (3, 5), (2,5), (2, 3, 5} and φ or {}.

Proper Subsets: 0), (2), (3), (5), (2,3), (3, 5), (2,5)

This can be denoted as {}, {2}, {3}, {5}, (2,3), (3, 5), (2,5) ⊂ P.

Improper Subset: {2, 3, 5).

This can be denoted as {2, 3, 5} ⊆ P.

Subset Formula

Mathematicians introduced set theory symbols to represent collections of objects. If there is a need to choose n elements from a set containing N element, it can be done in $^{N}C_{n}$ ways.

Proper Subset Formula

If a set contains "n" elements, the total number of subsets for that set is 2^n, and the number of proper subsets can be calculated using the formula $2^n - 1$.

Ex. Identify the proper subset for a set P with the elements {1, 2}.

Sol. The formula for proper subsets is $2^n - 1$ where n represents the number of elements in the set.
P = {1, 2}
Total number of elements (n) in the set=2
Hence the number of proper subset=$2^2 - 1 = 3$
Therefore the total number of proper subsets for the given set is {}, {1}, and {2}.

Represent Subsets

We have a clear understanding of what a subset is; now let's examine some representations for it. A subset, similar to any other set, is denoted with its elements inside curly braces.
Consider two sets, X and Y:

$$X \subseteq Y$$

The notation {X} signifies that X is a subset of Y.

$$X \subsetneq Y$$

In this case, the notation {X} indicates that X is not a subset of Y.

$$X \subset Y$$

If X is a proper subset of Y, it is represented by the above notation.

$$X \not\subseteq \mathcal{Y}$$

If X is not a proper subset of Y, it is denoted by the above notation.

Properties Of Subsets

Here are some key properties of subsets:

- Every set is considered a subset of itself. Whether the set is finite or infinite, it is always regarded as a subset of itself.
  For instance, for a finite set A = {3, 6}, all possible subsets include:
  $$A = \{\}, \{3\}, \{6\}, \{3,6\}$$
  It's noticeable that a subset with identical elements as the original set is included to fulfill this property.
- We can assert that the empty set is considered a subset of every set.
  For example, Consider a finite set B = {(a, b), In this case, all possible subsets of the set B are:
  $$A = \{\}, \{a\}, \{b\}, \{a, b\}$$
- If P is a subset of Q, it implies that all elements in P are present in Q. Take, for instance, a set P = {2, 6, 9} and another set Q = {2, 3, 4, 5, 6, 7, 8, 9}. In this case, we can affirm that P is a subset of Q, as all elements of P are found in Q.
- If set A is a subset of set B, we can infer that B is a superset of A.
- A given set of data yields 2n subsets and 2n - 1 proper subsets.

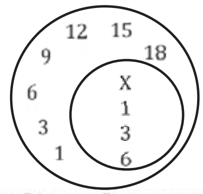
Representation Of Subsets Through Venn Diagrams

To grasp the relationships between various sets, the Venn diagram serves as the most suitable tool to depict logical connections among specific sets. It is extensively utilized for illustrating sets, particularly for finite sets.

A Venn diagram represents sets as areas inside a circular target, with elements depicted as points within the area. As subsets typically involve two sets, a Venn diagram is a convenient way to illustrate and visualize them.

Ex. Create a Venn diagram for the sets X = {1, 3, 6} and Y = {1, 3, 6, 9, 12, 15, 18}.

Sol. The Venn diagram representations of sets X and Y are depicted below:



Venn Diagram Representation Of Subsets

From the diagram, it is evident that X, enclosed within its designated area, constitutes a segment of the Y region. Each region displays its elements as points inside the corresponding area.

Difference Between Proper Subset And Superset

A source of common confusion for students beginning to study set theory is often the distinction between a proper subset and a superset. Let's clarify these concepts with an **example:**

As explained in the article, a set P is a proper subset of Q if Q contains at least one element not present in P. This relationship is denoted by the symbol ⊂.

On the other hand, Q is considered the superset of P only if every element in P is also part of Q, indicating that Q is larger in size compared to P. If P is identified as the proper subset of Q, then Q is the superset of P, symbolized by the symbol ⊇.

Ex. Examine whether set X = {2, 4, 6, 8} is a superset of set Y = {2, 4, 6}.

Sol. For X to qualify as a superset of Y, it must encompass all the elements contained in set Y. As evident from the provided information, X includes all the elements present in Y. Moreover, Y is a proper subset of X; thus, X serves as the superset for Y.

Intervals As Subsets Of R:

An interval is like a group of real numbers. If you find any number between two numbers in that group, it's also part of the group.

Let a, b ∈ R and a < b then the subsets of real numbers can be designated as below.

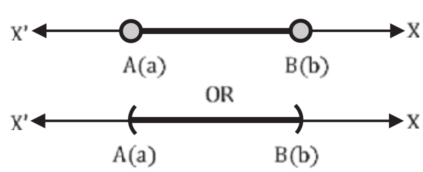
1. Open interval:

The collection of all real numbers that are between a and b creates what's called an open interval. We represent this as (a, b).

$$(a, b) = \{y: y \in R, a < y < b\}.$$

In a visual representation, consider points A and B on the real number line, where A corresponds to the real number a, and B corresponds to the real number b.

The open interval (a, b) geometrically encompasses all points situated to the right of A and to the left of B on the real axis. This arrangement is visually depicted on the real number line in the following manner.

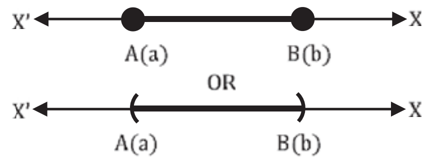


2. Closed interval:

The group of all real numbers that fall between a and b, including both a and b, is called a closed interval. We represent this as [a, b].

$$[a, b] = \{y : y \in R, a \leq y \leq b\}$$

It is represented on real axis as follows



3. Semi open/closed:

The collection of real numbers between a and b, which includes b but not a, is known as an open-closed interval. This interval is open on the left side but closed on the right. We denote it as (a, b].

$$(a, b] = \{y : y \in R, a < y \leq b\}$$

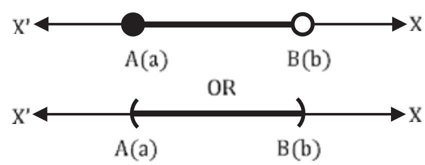
It is represented on real axis as follows.

4. Semi closed/open:

The group of real numbers between a and b, which includes a but not b, makes up a closed-open interval. This interval is closed on the left side but open on the right. We represent it as [a, b).

$$[a, b) = \{y : y \in R, a \leq y < b\}$$

It is represented on the real axis as follows:

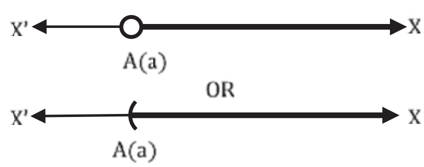


The intervals we talked about earlier are all limited, but there are also infinite intervals used in sets.

5. The group of real numbers, represented as y, where y is greater than a, creates an infinite interval. We symbolize this as (a, ∞).

Mathematically, $(a, \infty) = \{y : y \in R, y > a\}$

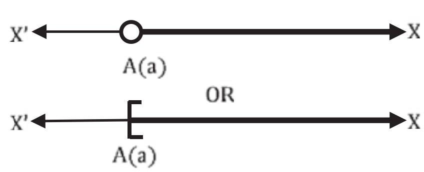
It is represented on the real axis as follows:



6. The collection of real numbers, denoted as y, where y is greater than or equal to a, makes an infinite interval. We represent this as [a, ∞).

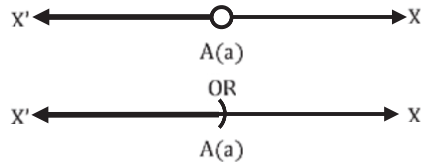
Mathematically $[a, \infty) = \{y : y \in R, y \geq a\}$

It is represent on the real axis as follows:



7. The group of real numbers, denoted as y, where y is less than a, creates an infinite interval. We represent this as (–∞, a).

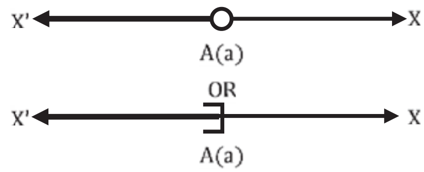
Mathematically $(-\infty, a) = \{y : y \in R, y < a\}$ It is represented on the real axis as follows:



8. The collection of real numbers, represented as y, where y is less than or equal to a, forms an infinite interval. This is symbolized as $(-\infty, a]$.

Mathematically, $(-\infty, a] = \{y: y \in R, y \leq a\}$

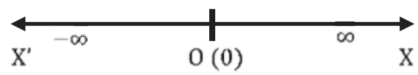
It is represented on the real axis as follows.



The set of all real numbers is an infinite interval. It is denoted by $(-\infty, \infty)$. i.e.

$$(-\infty, \infty) = \{y: y \in R\}$$

The real axis itself represents this interval.



Inequalities:

Two real number or two algebraic expressions related by the symbol ‘’, ‘≤’ or ‘≥’ from an inequality. e.g., $13 < 15$, $x \geq 30$

Some Properties Of Inequalities

1. If you add or subtract the same number from both sides of an inequality, the inequality remains unchanged.

2. If you multiply or divide both sides of an inequality by the same positive number (which is not zero), the inequality remains the same.

3. If you multiply or divide both sides of an inequality by the same negative number (which is not zero), the inequality is reversed.

Ex. If $2x - 5 \geq 21$ then find the interval to which x belongs.

Sol.
$$2x - 5 \geq 21$$
$$2x \geq 26$$
$$x \geq 13 \qquad \text{i.e., } x \in [13, \infty)$$

Ex. If x is a real number such that $x \geq 2$, then find the interval in which the following expression lie.

(i) $x + 8$ (ii) $2x + 6$ (iii) $11 - 3x$ (iv) $\frac{1}{x}$ (v) A^2

Sol. (i) As $x \geq 2$

$$\Rightarrow x + 8 \geq 2 + 8 \Rightarrow x + 8 \geq 10 \text{ or } x + 8 \in [10, \infty)$$

(ii) As $x \geq 2$

$2x \geq 4$

$$\Rightarrow 2x + 6 \geq 4 + 6 \Rightarrow 2x + 6 \geq 10 \text{ or } 2x + 6 \in [10, \infty)$$

(iii) As $x \geq 2$

$-3x \leq -6$

$$\Rightarrow 11 - 3x \leq 11 - 6 \Rightarrow 11 - 3x \leq 5 \text{ or } 11 - 3x \in (-\infty, 5)$$

(iv) As $x \geq 2$

$$\Rightarrow \frac{1}{x} \leq \frac{1}{2} \text{ or } \frac{1}{x} \in (0, \frac{1}{2}]$$

(v) As $x \geq 2$

$$\Rightarrow x^2 \geq 4 \text{ or } x^2 \in [4, \infty)$$

Ex. If x is real number such that $x \in [-2, 2]$ then find the interval in which following expression lie.

(i) $x + 7$ (ii) $x^2 + 1$

Sol. (i) As $-2 \le x \le 2$

$$-2 + 7 \le x + 7 \le 2 + 7$$
$$\Rightarrow 5 \le x + 7 \le 9 \text{ or } x + 7 \in [5,9]$$

(ii) As $-2 \le x \le 2$

$$\Rightarrow 0 \le x^2 \le 4 \Rightarrow 1 \le x^2 + 1 \le 5 \text{ or } x^2 + 1 \in [1,5]$$

POWER SET

The collection of all subsets of a set A is referred to as the power set of A, denoted by P(A) or 2^A.

$$P(A) = \{x: x \subseteq A\}$$
$$x \in P(A) \Leftrightarrow x \subseteq A$$
$$\phi \in P(A) \text{ and } A \in P(A)$$

Example: $A = \{1,2,3\}$

$$P(A) = 2^A = \{\phi, \{1\}, \{2\}, \{3\}, \{1,2\}, \{1,3\}, \{2,3\}, \{1,2,3\}\}$$
$$n(A) = 3son(2^A) = 2^3 = 8$$

1. If A has n elements, then its power set P (A) contains 2^n elements. nP (A)= 2^n.

2. Both the empty set (ϕ) and A belong to P (A).

3. If $A = \phi$ then P (A) = $\{\phi\}$ is a singleton set.

4. If A = {t} then P (A) {ϕ, {t}} is a pair set.

5. If cardinal number of set A is n then total number of subsets of $P(A) = 2^{2^n}$ and proper subsets $2^{2^n} = -1$

6. If $A \subseteq B \Rightarrow P(A) \subseteq P(B)$

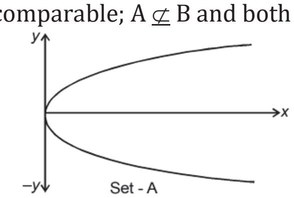
Ex. $A = \{(x, y): y^2 = x, x \in R\}$ and $B = \{(x, y): y = \sqrt{x}, x \in R\}$. Choose the correct option/options from the following.

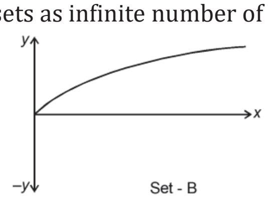
(a) A = B (b) $B \subset A$ and $A \subseteq B$

(c) A and B are comparable sets. (d) A and B both are infinite sets.

Sol. (c) and (d)

Set A and Set B include all the points lying on the respective curves below. Clearly $A \neq B$, $B \subset A$, so A and B are comparable; $A \not\subseteq B$ and both are infinite sets as infinite number of points satisfy each.





Ex. Demonstrate that if set A contains n elements then its power set has 2^n elements.

Sol he ways to choose r items from a collection of n distinct items are expressed by

$${}^nC_r = \frac{n(n-1)(n-2)\ldots \text{ uptor terms}}{r} \text{ where}$$
$$\lfloor r = 1.2.3 \ldots.r.$$

The number of subsets of A having no element = ${}^nC_0 = 1$i. e. ϕ

The number of subsets of A having one element = ${}^nC_1$

The number of subsets of A having two elements = ${}^nC_2$

- -

The number of subsets of A having n elements = ${}^nC_n$

Thus, total number of subsets of A = ${}^nC_0 + {}^nC_1 + {}^nC_2 + \ldots\ldots. + {}^nC_n =$

$= (1 + 1)^2 = 2^n$ (by binomial theorem)

UNIVERSAL SET

Any set that is the superset of all the sets in question is referred to as the universal set (denoted as S or U). The selection of the universal set is not unique, but once chosen, it remains fixed for the duration of that discussion.

Example:

Let	A = {a, e, i}; B = {i, o, u}; C = {e, f}
Then	U = {a, e, i, o, u, f}
Or	U = {a, e, i, p, o, u, f, g}
Or	U = Set of all English alphabet.

Ex. Mark T/F against the each statement given below:

(a) Every set has at least one proper subset.

(b) If A is a finite, non-void set, having n proper subsets and m subsets then $n - m \in N$.

(c) $A = \{\phi, \{\phi\}\}$ then cardinal number of P (A) is 4.

(d) $a \subseteq \{a, \{b\}, \{c\}\}$

(e) Set of all squares in a plane' is a subset of 'all rectangles in the same plane'.

Sol. (a) F (b) F (c) T (d) F (e) T

(a) Void set {}, has no proper subset.

(b) $n - m = -1 \notin N$

(c) $P(A) = \{\phi, \{\phi\}, \{\{\phi\}\}, \{\phi, \{\phi\}\}\}$ so $n\{P(A)\} = 4$.

(d) As 'a' is not a set, it cannot be considered a subset. Every subset is inherently a set.

(e) Each square is also a rectangle thus it is accurate.

Ex. Match the following columns.

(a) A = letters of word 'ball'
B = letters of word 'lab' — (i) $P(A) \subset P(B)$

(b) $A \subset B$ — (ii) A and B are incomparable

(c) $A = \{x: \cos x > \frac{-1}{2} \text{ and } 0 \le x \le \pi\}$ — (iii) A = B
$B = \{x: \sin x > \frac{1}{2} \text{ and } \frac{\pi}{3} \le x \le \pi\}$

(d) $A = \{(x, y): x^2 + y^2 \le 1, x, y \in R\}$ — (iv) $A \supset B$
$B = \{(x, y): 0 \le x \le \frac{1}{2} \text{ and } y = 0\}$

Sol. (a)(iii) (b)(i) (c)(ii) (d)(iv)

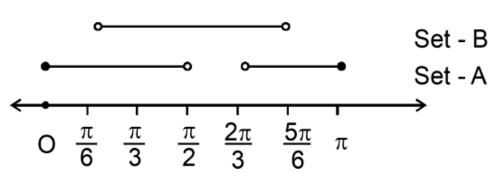
(a) A = {a, b, l}; B = {l, a, b}
Clearly A = B, A and B are comparable P (A) = P(B)

$P(A) \not\subset P(B)$; $A \not\supset B$.

Hence answer (iii) only.

(b) If $A \subset B$ then $P(A) \subset P(B)$; A and B are comparable, $A \ne B$, $A \not\supset B$.
Hence answer (i) only.

(c) A and B are as shown on number line.



Clearly $P(A) \not\subset P(B)$

A and B are not comparable.

$A \ne B$ and $A \not\supset B$.

Hence answers (ii) only.

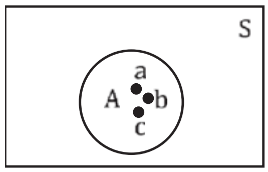
(d) A is all points within on a circle of radius 1 and center (0, 0). B contains only the points lying on x-axis within the circle such that $0 \le x \le$,

So clearly $B \subset A$; $B \neq A$, A and B are comparable $P(A) \not\subset P(B)$.

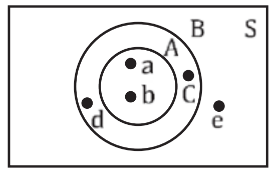
Hence only correct answer is (iv).

VENN DIAGRAMS

Originating from Euler, a Swiss mathematician, and attributed to John Venn, this graphical depiction illustrates sets. In this representation, a set is depicted by a circle or a closed geometric shape within a universal set, typically represented by a rectangle. Each element of a set is denoted by a point located inside the corresponding circle representing that set.



$A = \{a, b, c,\}$



$A \subset B$; $A = \{a, b\}$; $B = \{a, b, c, d\}$; $e \notin A$; $e \notin B$