Sets

Exercise 1A

Q. 1 A. Which of the following are sets? Justify your answer.

The collection of all whole numbers less than 10.

Answer : Whole numbers are 0, 1, 2, 3, …

Whole numbers less than 10 are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

As the collection of all whole numbers, less than 10 is known and can be counted, i.e. well – defined.

∴, this is a set.

Q. 1 B. Which of the following are sets? Justify your answer.

The collection of good hockey players in India.

Answer : As a collection of good hockey players in India may vary from person to person.

So, it is not well – defined.

∴, this is not a set.

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Q. 1 C. Which of the following are sets? Justify your answer.

The collection of all the questions in this chapter.

Answer : As the collection of all questions in this chapter is known and can be counted .i.e. well – defined.

∴, this is a set.

Q. 1 D. Which of the following are sets? Justify your answer.

The collection of all the difficult chapters in this book.

Answer : As the collection of all difficult chapters in this book may vary from person to person.

∴, this is not a set.

Q. 1 E. Which of the following are sets? Justify your answer.

A collection of Hindi novels written by Munshi Prem Chand.

Answer : As the collection of Hindi novels written by Munshi Prem Chand is known and can be counted, i.e. well – defined.

∴, this is a set.

Q. 1 F. Which of the following are sets? Justify your answer.

A team of 11 best cricket players of India.

Answer : As a collection of 11 best cricket players of India may vary from person to person.

So, it is not well – defined.

∴, this is not a set.

Q. 1 G. Which of the following are sets? Justify your answer.

The collection of all the months of the year whose names begin with the letter M.

Answer : Months of the Year = Jan, Feb, March, April, May, June, July, Aug, Sep, Oct, Nov, Dec

Months of the year whose names begin with the letter M are:

• March

• May

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As, the collection of all the months of the year whose names begin with the letter M is known and can be counted .i.e. well – defined.

∴, this is a set.

Q. 1 H. Which of the following are sets? Justify your answer.

The collection of all interesting books.

Answer : As the collection of all interesting books may vary to person to person.

∴, this is not a set.

Q. 1 I. Which of the following are sets? Justify your answer.

The collection of all short boys of your class.

Answer : As the collection of all short boys of your class may vary to person to person. Maybe someone consider short boys of height less than 120 cm and maybe someone consider short boys of height less than 90cm. Here, the set is not well – defined.

∴, this is not a set.

Q. 1 J. Which of the following are sets? Justify your answer.

The collection of all those students of your class whose ages exceed 15 years.

Answer : As the collection of all those students of your class whose ages exceed 15 years is known and can be counted, i.e. well – defined.

∴, this is a set

Q. 1 K. Which of the following are sets? Justify your answer.

The collection of all rich persons of Kolkata.

Answer : As the collection of all rich persons of Kolkata may vary from person to person. Someone considers a person whose income is Rs 1 lakh per annum as a rich person, and someone considers a person whose income is Rs 1 crore per annum as a rich person. Here, the set is not well – defined.

∴, this is not a set

Q. 1 L. Which of the following are sets? Justify your answer.

The collection of all persons of Kolkata whose assessed annual incomes exceed (say) Rs 20 lakh in the 4 financial years 2016-17.

Answer : As the collection of all persons of Kolkata whose assessed annual incomes exceed (say) Rs 20 lakh in the 4 financial years 2016-17 is known and well – defined.

∴, this is a set.

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Q. 1 M. Which of the following are sets? Justify your answer.

The collection of all interesting dramas written by Shakespeare.

Answer : As the collection of all interesting dramas written by Shakespeare is not well - defined because it depends on person interest.

∴, this is not a set.

Q. 2. Let A be the set of all even whole numbers less than 10.

(i) Write A in the roster from.

(ii) Fill in the blanks with the approximate symbol ∉ or ∈ :

(a) 0 …. A

(b) 10 …. A

(c) 3 …. A

(d) 6 …. A

Answer : (i) Whole numbers are 0, 1, 2, 3, …

Even whole numbers less than 10 are 0, 2, 4, 6, 8, 9

So, A = {0, 2, 4, 6, 8}

(ii) (a) Here, A = {0, 2, 4, 6, 8}

∈ - belongs to
∉ - does not belongs to

As 0 is in set A.

Hence, 0 ∈ A

(b) Here, A = {0, 2, 4, 6, 8}

∈ - belongs to
∉ - does not belongs to

As 10 is not in a set A

Hence, 10 ∉ A

∈ - belongs to
∉ - does not belongs to

(c) Here, A = {0, 2, 4, 6, 8}

As 3 is not in a set A

Hence, 3 ∉ A

(d) Here, A = {0, 2, 4, 6, 8}

∈ - belongs to
∉ - does not belongs to

As 6 is in set A

Hence, 6 ∈ A

Q. 3 A. Write the following sets in roster from:

A = {x : x is a natural number, 30 ≤ x < 36}.

Answer : Natural numbers = 1, 2, …, 30, 31, 32, 33, 34, 35, 36, …

The elements of this set are 30, 31, 32, 33, 34 and 35 only

So, A = {30, 31, 32, 33, 34, 35}

Q. 3 B. Write the following sets in roster from:

B = {x : x is an integer and –4 < x < 6}.

Answer : Integers = …-6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7,…

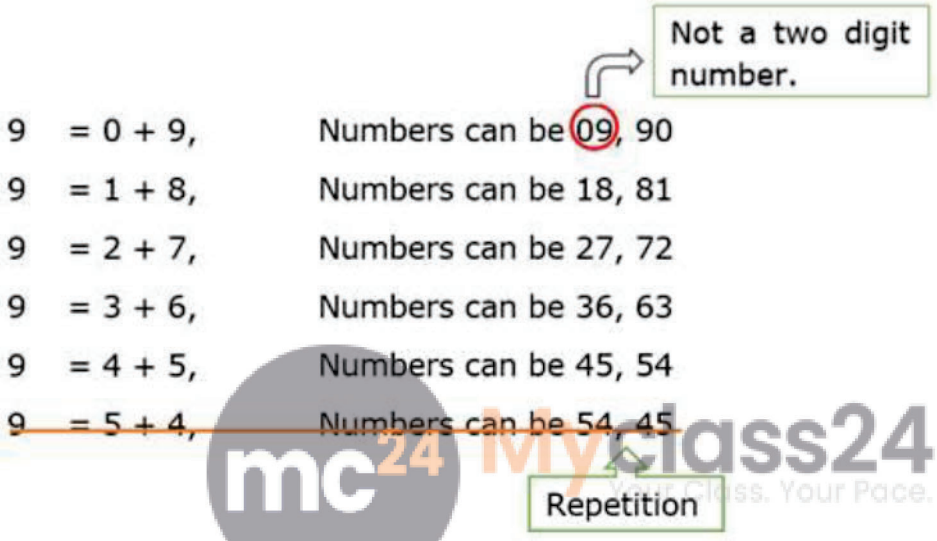
The elements of this set are -3, -2, -1, 0, 1, 2, 3, 4 and 5 only.

So, B = {-3, -2, -1, 0, 1, 2, 3, 4, 5}

Q. 3 C. Write the following sets in roster from:

C = {x : x is a two-digit number such that the sum of its digits is 9}.

Answer :



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The elements of this set are 18, 27, 36, 45, 54, 63, 72, 81 and 90

So, C = {18, 27, 36, 45, 54, 63, 72, 81, 90}

Q. 3 D. Write the following sets in roster from:

D = {x : x is an integer, $x^2 \leq 9$}.

Answer : Integers = …, -4, -3, -2, -1, 0, 1, 2, 3, 4, …

$x = -4$, $x^2 = (-4)^2 = 16 > 9$

$x = -3$, $x^2 = (-3)^2 = 9$

$x = -2$, $x^2 = (-2)^2 = 4$

$x = -1$, $x^2 = (-1)^2 = 1$

$x = 0$, $x^2 = (0)^2 = 0$

$x = 1, x^2 = (1)^2 = 1$

$x = 2, x^2 = (2)^2 = 4$

$x = 3, x^2 = (3)^2 = 9$

$x = 4, x^2 = (4)^2 = 16$

The elements of this set are -3, -2, -1, 0, 1, 2, 3

So, D = {-3, -2, -1, 0, 1, 2, 3}

Q. 3 E. Write the following sets in roster from:

E = {x : x is a prime number, which is a divisor of 42}.

Answer : Prime number = Those number which is divisible by 1 and the number itself.

Prime numbers are 2, 3, 5, 7, 11, 13, …

Divisor of 42:

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42 = 1 × 42

42 = 2 × 21

42 = 3 × 14

42 = 6 × 7

So, divisors of 42 are 1, 2, 3, 6, 7, 14, 21, 42

The elements which are prime and divisor of 42 are 2, 3, 7

So, E = {2, 3, 7}

Q. 3 F. Write the following sets in roster from:

F = {x : x is a letter in the word' MATHEMATICS'}.

Answer : There are 11 letters in the word MATHEMATICS, out of which M, A and T are repeated.

So, F = {M, A, T, H, E, I, C, S}

Q. 3 G. Write the following sets in roster from:

G = {x : x is a prime number and 80 < x < 100}.

Answer : Prime number = Those number which is divisible by 1 and the number itself.

Prime numbers are 2, 3, 5, 7, 11, 13,…

The numbers 80 < x < 100 are

81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

The elements which are prime and lies between 80 and 100 are 83, 89, 97

So, G = {83, 89, 97}

Q. 3 H. Write the following sets in roster from:

H = {x : x is a perfect square and x < 50}.

Answer : Perfect squares are:

$0^2 = 0$

$1^2 = 1$

$2^2 = 4$

$3^2 = 9$

$4^2 = 16$

$5^2 = 25$

$6^2 = 36$

$7^2 = 49$

$8^2 = 64 > 50$

The elements which are perfect square and x < 50 are 0, 1, 2, 3, 4, 5, 6, 7

Q. 3 I. Write the following sets in roster from:

J = {x : ϵ R and $x^2 + x - 12 = 0$}.

Answer : The given equation is:

$x^2 + x - 12 = 0$

$\Rightarrow x^2 + 4x - 3x - 12 = 0$

$\Rightarrow x(x + 4) - 3(x + 4) = 0$

$\Rightarrow (x - 3)(x + 4) = 0$

$\Rightarrow x - 3 = 0$ or $x + 4 = 0$

$\Rightarrow x = 3$ or $x = -4$

therefore, the solution set of the given equation can be written in roaster form as {3, -4}

So, J = {3, -4}

Q. 3 J. Write the following sets iroster from:

K = {x : ϵ N, x is a multiple of 5 and $x^2 < 400$}.

Answer : Multiple of 5 are 5, 10, 15, 20, 25, 30, …

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So, $5^2 = 25$

$10^2 = 100$

$15^2 = 225$

$20^2 = 400$

$25^2 = 625 > 400$

The elements which are multiple of 5 and $x^2 < 400$ are 5, 10, 15

So, K = {5, 10, 15}

Q. 4 A. List all the elements of each of the sets given below.

A = {x : x = 2n, n ϵ N and n ≤ 5}.

Answer : Given: x = 2n and n ≤ 5

⇒ n = 1, 2, 3, 4 and 5 [∵ n ∈ N]

Given x = 2n

n = 1, x = 2 × 1 = 2

n = 2, x = 2 × 2 = 4

n = 3, x = 2 × 3 = 6

n = 4, x = 2 × 4 = 8

n = 5, x = 2 × 5 = 10

So, the elements of A are 2, 4, 6, 8 and 10

∴, A = {2, 4, 6, 8, 10}

Q. 4 B. List all the elements of each of the sets given below.

B = {x : x = 2n + 1, n ∈ W and n ≤ 5}.

Answer : Given: x = 2n + 1 and n ≤ 5

⇒ n = 0, 1, 2, 3, 4 and 5 [∵ n ∈ W]

Given x = 2n + 1

n = 0, x = 2 × 0 + 1 = 1

n = 1, x = 2 × 1 + 1 = 3

n = 2, x = 2 × 2 + 1 = 5

n = 3, x = 2 × 3 + 1 = 7

n = 4, x = 2 × 4 + 1 = 9

n = 5, x = 2 × 5 + 1 = 11

So, the elements of B are 1, 3, 5, 7, 9 and 11

∴, B = {1, 3, 5, 7, 9, 11}

Q. 4 C. List all the elements of each of the sets given below.

$$C = \{x : x = \frac{1}{n}, n \in N \text{ and } n \leq 6\}$$

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Answer : Here, $x = \frac{1}{n}$ and n ≤ 6

So, n = 1, 2, 3, 4, 5 and 6 [∵n ∈ N]

Given: $x = \frac{1}{n}$

$n = 1, x = \frac{1}{1} = 1$

$n = 2, x = \frac{1}{2}$

$n = 3, x = \frac{1}{3}$

$n = 4, x = \frac{1}{4}$

$n = 5, x = \frac{1}{5}$

$n = 6, x = \frac{1}{6}$

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$So, C = \left\{1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}\right\}$

Q. 4 D. List all the elements of each of the sets given below.

D = {x : x = n^2, n ∈ N and 2 ≤ n ≤ 5}.

Answer : Here, x = n^2 and 2 ≤ n ≤ 5

∴ n = 2, 3, 4, 5

[it is given that n is less than equal to 2 and greater than equal to 5]

If

n = 2, x = $(2)^2$ = 4

n = 3, $x = (3)^2 = 9$

n = 4, $x = (4)^2 = 16$

n = 5, $x = (5)^2 = 25$

So, D = {4, 9, 16, 25}

Q. 4 E. List all the elements of each of the sets given below.
$E = \{x : x \in Z \text{ and } x^2 = x\}$.

Answer : Given: $x \in Z$ and $x^2 = x$

Z is a set of integers

Integers are …-2 , -1, 0, 1, 2, …

Now, if we take x = -2 then we have to check that it satisfies the given condition $x^2 = x$

$(-2)^2 = 4 \neq 2$

So, $-2 \notin E$

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If x = -1 then $(-1)^2 = 1 \neq -1$ [not satisfying $x^2 = x$]

So, $-1 \notin E$

If x = 0 then $(0)^2 = 0$ [satisfying $x^2 = x$]

$\therefore 0 \in E$

If x = 1 then $(1)^2 = 1$ [satisfying $x^2 = x$]

$\therefore 1 \in E$

If x = 2 then $(2)^2 = 4 \neq 2$ [not satisfying $x^2 = x$]

$\Rightarrow 2 \notin E$

So, E = {0, 1}

Q. 4 F. List all the elements of each of the sets given below.

$$F = \{x : x = \in Z \text{ and } -\frac{1}{2} < X\frac{13}{2}\}.$$

Answer : Given x ∈ Z and

$$-\frac{1}{2} < x < \frac{13}{2}$$

It can be seen that

$$-\frac{1}{2} = -0.5 \ \& \frac{13}{2} = 6.5$$

We know that, Z means Set of integers

∴ F = {0, 1, 2, 3, 4, 5, 6}

Q. 4 G. List all the elements of each of the sets given below.

$$G = \{x : x = \frac{1}{(2n-1)'} n \in N \text{ and } 1 \le n \le 5$$

Answer : Given:

$$x = \frac{1}{2n-1} \text{ and } 1 \le n \le 5$$

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So, n = 1, 2, 3, 4, 5

$$If\ n = 1, then\ x = \frac{1}{2n-1} = \frac{1}{2(1)-1} = \frac{1}{1} = 1$$

$$If\ n = 2, then\ x = \frac{1}{2n-1} = \frac{1}{2(2)-1} = \frac{1}{4-1} = \frac{1}{3}$$

$$If\ n = 3, then\ x = \frac{1}{2n-1} = \frac{1}{2(3)-1} = \frac{1}{6-1} = \frac{1}{5}$$

$$If\ n = 4, then\ x = \frac{1}{2n-1} = \frac{1}{2(4)-1} = \frac{1}{8-1} = \frac{1}{7}$$

$$If\ n = 5, then\ x = \frac{1}{2n-1} = \frac{1}{2(5)-1} = \frac{1}{10-1} = \frac{1}{9}$$

So, $G = \left\{1, \frac{1}{3}, \frac{1}{5}, \frac{1}{7}, \frac{1}{9}\right\}$

Q. 4 H. List all the elements of each of the sets given below.

H = {x : x ∈ Z, |x| ≤ 2}.

Answer : Given x ∈ Z and |x| ≤ 2

Z is a set of integers

Integers are …-3, -2 , -1, 0, 1, 2, 3, …

Now, if we take x = -3 then we have to check that it satisfies the given condition |x| ≤ 2

|-3| = 3 > 2

So, -3 ∉ H

If x = -2 then |-2| = 2 [satisfying |x| ≤ 2]

So, -2 ∈ H

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If x = -1 then |-1| = 1 [satisfying |x| ≤ 2]

∴ -1 ∈ H

If x = 0 then |0| = 0 [satisfying |x| ≤ 2]

∴ 0 ∈ H

If x = 1 then |1| = 1 [satisfying |x| ≤ 2]

⇒ 1 ∈ H

If x = 2 then |2| = 2 [satisfying |x| ≤ 2]

So, 2 ∈ H

If x = 3 then |3| = 3 > 2 [satisfying |x| ≤ 2]

So, 3 ∉ H

So, H = {-2, -1, 0, 1, 2}

So, E = {0, 1}

Q. 5. Write each of the sets given below in set7builder from:

(i)

$$A = \left\{1, \frac{1}{4}, \frac{1}{9}, \frac{1}{16}, \frac{1}{25}, \frac{1}{36}, \frac{1}{49}\right\}.$$

(ii)

$$B = \left\{\frac{1}{2}, \frac{2}{5}, \frac{3}{10}, \frac{4}{17}, \frac{5}{26}, \frac{6}{37}, \frac{7}{50}\right\}.$$

(iii) C = {53, 59, 61, 67, 71, 73, 79}.
(iv) D = {–1, 1}.
(v) E = {14, 21, 28, 35, 42, …., 98}.

Answer :

$$A = \left\{1, \frac{1}{4}, \frac{1}{9}, \frac{1}{16}, \frac{1}{25}, \frac{1}{36}, \frac{1}{49}\right\}$$

$$= \left\{\left(\frac{1}{1}\right)^2, \left(\frac{1}{2}\right)^2, \left(\frac{1}{3}\right)^2, \left(\frac{1}{4}\right)^2, \left(\frac{1}{5}\right)^2, \left(\frac{1}{6}\right)^2, \left(\frac{1}{7}\right)^2\right\}$$

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Hence, we may write the set as

$$A = \left\{x : x = \frac{1}{n^2}, n \in N \text{ and } 1 \leq n \leq 7\right\}$$

(ii) $B = \left\{\frac{1}{2}, \frac{2}{5}, \frac{3}{10}, \frac{4}{17}, \frac{5}{26}, \frac{6}{37}, \frac{7}{50}\right\}$

$$= \left\{\frac{1}{1+1}, \frac{2}{4+1}, \frac{3}{9+1}, \frac{4}{16+1}, \frac{5}{25+1}, \frac{6}{36+1}, \frac{7}{49+1}\right\}$$

$$= \left\{\frac{1}{1^2+1}, \frac{2}{2^2+1}, \frac{3}{3^2+1}, \frac{4}{4^2+1}, \frac{5}{5^2+1}, \frac{6}{6^2+1}, \frac{7}{7^2+1}\right\}$$

Hence, we may write the set as

$$B = \left\{x : x = \frac{n}{n^2+1}, n \in N \text{ and } 1 \leq n \leq 7\right\}$$

(iii) C = {53, 59, 61, 67, 71, 73, 79}

We know that prime numbers are those numbers which are divisible by 1 and the number itself.

e.g. $\frac{3}{1} = 3 \; and \; \frac{3}{3} = 1$

Here, all the given numbers are consecutive prime numbers greater than 50.

So, C = {x: x is a prime number and 50 < x < 80}

(iv) Here, in set D there are two elements -1 and 1

-1 and 1 are integers

So, the given set can be write as

D = {x: x is an integer and -2 < x < 2}

(v) 14 = 7 × 2

21 = 7 × 3

28 = 7 × 4

35 = 7 × 5

42 = 7 × 6

.

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98 = 7 × 14

So, the given set can be write as

E = {x: x = 7n, n ∈ N and 1 ≤ n ≤ 14}

Q. 6. Match each of the sets on the left described in the roster from with the same set on the right described in the set-builder from:

	Column I		Column II
(i)	{–5, 5}	**(a)**	{x : x ∈ Z and x^2 < 16}
(ii)	{1, 2, 3, 6, 9, 18}	**(b)**	{x : x ∈ N and x^2 = x}
(iii)	{–3, –2, –1, 0, 1, 2, 3}	**(c)**	{x : x = ∈ Z and x^2 =25}
(iv)	{P, R, I, N, C, A, L}	**(d)**	{x : x ∈ N and x is a factor of 18}
(v)	{1}	**(e)**	{x : x is a letter in the word 'PRINCIPAL'}

Answer : (i) {-5, 5}

It can be seen that if we take the square of -5 and 5, the result will be 25

If x = -5, then $(-5)^2$ = 25

If x = 5, then $(5)^2$ = 25

and -5, 5 both are integers

So, {x : x ∈Z and x^2 = 25}

∴ **(i)** matches (c)

(ii) {1, 2, 3, 6, 9, 18}

Divisor of 18 are
18 = 18 × 1

18 = 9 × 2

18 = 6 × 3

1, 2, 3, 6, 9, 18 are divisors of 18

So, {x : x ∈ N and x is a factor of 18}

∴ **(ii)** matches (d)

(iii) {–3, –2, –1, 0, 1, 2, 3}

$(-3)^2$ = 9 < 16

$(-2)^2 = 4 < 16$

$(-1)^2 = 1 < 16$

$(0)^2 = 0 < 16$

$(1)^2 = 1 < 16$

$(2)^2 = 4 < 16$

$(3)^2 = 9 < 16$

All are the given elements are integers and satisfying $x^2 < 16$

So, **(iii)** matches (a)

(iv) {P, R, I, N, C, A, L}

There are 9 letters in the word PRINCIPAL out of which P and I are repeated.

So, {x : x is a letter in the word 'PRINCIPAL'}

∴ (iv) matches (e)

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(v) {1}

Since, $1 \in N$ and $(1)^2 = 1$

So, $\{x : x \in N \text{ and } x^2 = x\}$

∴ (v) matches (b)

	Column I		Column II
(i)	{−5, 5}	(a)	{x : x ∈ Z and x^2 < 16}
(ii)	{1, 2, 3, 6, 9, 18}	(b)	{x : x ∈ N and x^2 = x}
(iii)	{−3, −2, −1, 0, 1, 2, 3}	(c)	{x : x = ∈ Z and x^2 = 25}
(iv)	{P, R, I, N, C, A, L}	(d)	{x : x ∈ N and x is a factor of 18}
(v)	{1}	(e)	{x : x is a letter in the word 'PRINCIPAL'}

Exercise 1B

Q. 1 A. Which of the following are examples of the null set?

Set of odd natural numbers divisible by 2.

Answer : Natural numbers = 1, 2, 3, 4, 5,…

Odd Natural numbers = 1, 3, 5, 7, 9, 11, …

No odd natural number is divisible by 2.

∴ no elements in this set

∴ It is a null set.

Q. 1 B. Which of the following are examples of the null set?

Set of even prime numbers.

Answer : Prime numbers = Those numbers which are divisible by 1 and number itself.

Prime numbers = 2, 3, 5, 7, 11, 13,…

Even Prime number = 2

∴ set is not empty.

∴ It is not a null set

Q. 1 C. Which of the following are examples of the null set?

A = {x : x ∈ N, 1 < x ≤ 2}.

Answer : Natural numbers = 1, 2, 3, 4, 5, 6, 7,…

Natural number greater than 1 (1 < x) = 2, 3, 4, 5, ..

Natural number less than or equal to 2 (x ≥ 2) = 1

A number cannot be simultaneously greater than 1 and less than equal to 2

∴ no elements in this set

∴ It is a null set.

Q. 1 D. Which of the following are examples of the null set?

B = {x : x ϵ N, 2x + 3 = 4}.

Answer : Natural numbers = 1, 2, 3, 4, 5, 6,…

If x = 1, then 2x + 3 = 2(1) + 3 = 2 + 3 = 5 ≠ 4

∴ no elements in the set B because the equation 2x + 3 = 4 is not satisfied by any natural number of x.

∴ It is a null set.

Q. 1 E. Which of the following are examples of the null set?

C = {x : x is prime, 90 < x < 96}.

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Answer : Prime numbers = Those numbers which are divisible by 1 and number itself.

Prime numbers = 2, 3, 5, 7, 11, 13,…, 83, 89, 97, …

Prime number greater than 90 = 97

Prime number less than 96 = 89

Prime number less than 96 but greater than 90 = ϕ

∴ The set is empty

∴ It is a null set

Q. 1 F. Which of the following are examples of the null set?

D = {x : x ϵ N, x^2 + 1 = 0}.

Answer : Natural numbers = 1, 2, 3, 4, 5, 6,…

If x = 1, then $x^2 + 1 = (1)^2 + 1 = 1 + 1 = 2 \neq 0$

∴ no elements in the set B because the equation 2x + 3 = 4 is not satisfied by any natural number of x.

∴ It is a null set.

Q. 1 G. Which of the following are examples of the null set?

E = {x : x ∈ W, x + 3 ≤ 3}.

Answer : Whole numbers = 0, 1, 2, 3, …

If we take x = 0 then x + 3 = 0 + 3 = 3

If we take x = 1 then x + 3 = 1 + 3 = 4 > 3

So, 0 is the element of set E because it satisfies the given equation.

∴ It is not a null set.

Q. 1 H. Which of the following are examples of the null set?

F = {x : x ∈ Q, 1 < x < 2}.

Answer : Here, x ∈ Q

i.e. x is a rational number

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We know that,

If a and b are two rational numbers, then $\frac{a+b}{2}$ is a rational number between a and b such that $a < \frac{a+b}{2} < b$

So, the rational number 1 and 2 is

$$\frac{1+2}{2} = \frac{3}{2}$$

∴ the set is not empty

∴ It is not a null set.

Q. 1 I. Which of the following are examples of the null set?

G = {0}

Answer : Since, 0 ∈ G

∴ the set is not empty

∴ It is not a null set

Q. 2. Which of the following are examples of the singleton set?

(i) {x : $x \in Z$, $x^2 = 4$}.
(ii) {x : x ∈ Z, x + 5 = 0}.
(iii) {x : x ∈ Z, |x| = 1}.
(iv) {x : x ∈ N, $x^2 = 16$}.
(v) {x : x is an even prime number}

Answer : (i) Integers = …-3, -2, -1, 0, 1, 2, 3, …

Given equation:

$x^2 = 4$

⇒ $x = \sqrt{4}$

⇒ $x = \pm 2$

If x = -2, then $x^2 = (-2)^2 = 4$

If x = 2, then $x^2 = (2)^2 = 4$

So, there are two elements in a set.

∴ It is not a singleton set.

(ii) Integers = -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, …

Given equations:

x + 5 = 0

⇒ x + 5 – 5 = 0 – 5

⇒ x = -5

So, there is only 1 element in a given set.

∴ It is a singleton set.

(iii) Integers = …, -2, -1, 0, 1, 2, …

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Given equation: |x| = 1

If x = -1, then |x| = |-1| = 1

If x = 1, then |x| = |1| = 1

So, there are 2 elements in a given set

∴ It is not a singleton set.

(iv) Natural Numbers = 1, 2, 3, …

Given equation:

$x^2 = 16$

⇒ $x = \sqrt{16}$

⇒ $x = \pm 4$

⇒ x = -4, 4

but x = -4 not possible because $x \in N$

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So, there is only 1 element in a set.

∴ It is a singleton set.

(v) Prime number = 2, 3, 5, 7, 11, …

Even Prime number = 2

∴ It is a singleton set.

Q. 3 A. Which of the following are pairs of equal sets?

A = set of letters in the word, 'ALLOY.'

B = set of letters in the word, 'LOYAL.'

Answer : Equal Sets = Two sets A and B are said to be equal if they have exactly the same elements & we write A = B

We have,

A = set of letters in the word, ALLOY

A = {A, L, O, Y}

and B = set of letters in the word, LOYAL

B = {L, O, Y, A}

Here, A = B because the elements in both the sets are equal. The repetition of elements in a set does not change a set.

Thus, A and B are equal sets.

Q. 3 B. Which of the following are pairs of equal sets?

C = set of letters in the word, 'CATARACT.'

D = set of letters in the word, 'TRACT.'

Answer : Equal Sets = Two sets A and B are said to be equal if they have exactly the same elements & we write A = B

We have,

C = set of letters in the word, 'CATARACT.'

C = {C, A, T, R}

and D = set of letters in the word, 'TRACT.'

D = {T, R, A, C}

Here, C = D because the elements in both the sets are equal. The repetition of elements in a set does not change a set.

Thus, C and D are equal sets.

Q. 3 C. Which of the following are pairs of equal sets?

E = {x : x ϵ Z, $x^2 \leq 4$} and F = {x : x ϵ Z, $x^2 = 4$}.

Answer : Equal Sets = Two sets A and B are said to be equal if they have exactly the same elements & we write A = B

We have,

E = {x : x ϵ Z, $x^2 \leq 4$}

Here, $x \in Z$ and $x^2 \leq 4$

If $x = -2$, then $x^2 = (-2)^2 = 4 = 4$

If $x = -1$, then $x^2 = (-1)^2 = 1 < 4$

If $x = 0$, then $x^2 = (0)^2 = 0 < 4$

If $x = 1$, then $x^2 = (1)^2 = 1 < 4$

If $x = 2$, then $x^2 = (2)^2 = 4 = 4$

So,

$E = \{-2, -1, 0, 1, 2\}$

and $F = \{x : x \in Z, x^2 = 4\}$

Here, $x \in Z$ and $x^2 = 4$

If $x = -2$, then $x^2 = (-2)^2 = 4 = 4$

If $x = 2$, then $x^2 = (2)^2 = 4 = 4$

So, $F = \{-2, 2\}$

$\therefore E \neq F$ because the elements in the both the sets are not equal.

Q. 3 D. Which of the following are pairs of equal sets?

$G = \{-1, 1\}$ and $H = \{x : x \in Z, x^2 - 1 = 0\}$.

Answer : Equal Sets = Two sets A and B are said to be equal if they have exactly the same elements & we write A = B

We have,

$G = \{-1, 1\}$

and $H = \{x : x \in Z, x^2 - 1 = 0\}$

Here, $x \in Z$ and $x^2 - 1 = 0$

The given equation can be solved as:

$x^2 - 1 = 0$

$\Rightarrow x^2 = 1$

$\Rightarrow x = \sqrt{1}$

$\Rightarrow x = \pm 1$

$\therefore x = -1$ and 1

$\therefore H = \{-1, 1\}$

$\Rightarrow G = H$ because elements of both the sets are equal.

Q. 3 E. Which of the following are pairs of equal sets?

J = {2, 3} and K = {x : x ∈ Z, $(x^2 + 5x + 6) = 0$}

Answer : Equal Sets = Two sets A and B are said to be equal if they have exactly the same elements & we write A = B

We have,

J = {2, 3}

and K = {x : x ∈ Z, $(x^2 + 5x + 6) = 0$}

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Here, x ∈ Z and $x^2 + 5x + 6 = 0$

The given equation can be solved as:

$x^2 + 5x + 6 = 0$

$\Rightarrow x^2 + 2x + 3x + 6 = 0$

$\Rightarrow x(x + 2) + 3(x + 2) = 0$

$\Rightarrow (x + 2)(x + 3) = 0$

$\Rightarrow x = -2$ and -3

$\therefore K = \{-2, -3\}$

$\therefore J \neq K$ because elements of both the sets are not equal.

Q. 4. Which of the following are pairs of equivalent sets?

(i) A = {–1, –2, 0} and B = { 1, 2, 3,}

(ii) C = {x : x ∈ N, x < 3} and D ={x : x ∈ W, x < 3}

(iii) E = {a, e, i, o, u} and F = {p, q, r, s, t}

Answer : (i) Equivalent Sets can have different or same elements but have the same amount of elements.

We have,

A = {–1, –2, 0} and B = {1, 2, 3,}

∴ A and B are equivalent sets because both have 3 elements in their set.

(ii) Equivalent Sets can have different or same elements but have the same amount of elements.

We have,

C = {x : x ∈ N, x < 3}

Natural numbers = 1, 2, 3, 4, …

Natural numbers less than 3 (x < 3) = 1, 2

So, C = {1, 2}

and D ={x : x ∈ W, x < 3}

Whole numbers = 0, 1, 2, 3, 4, …

Whole numbers less than 3 (x < 3) = 0, 1, 2

So, D = {0, 1, 2}

∴ C and D are not equivalent sets because their cardinality is not same.

(iii) Equivalent Sets can have different or same elements but have the same amount of elements.

We have,

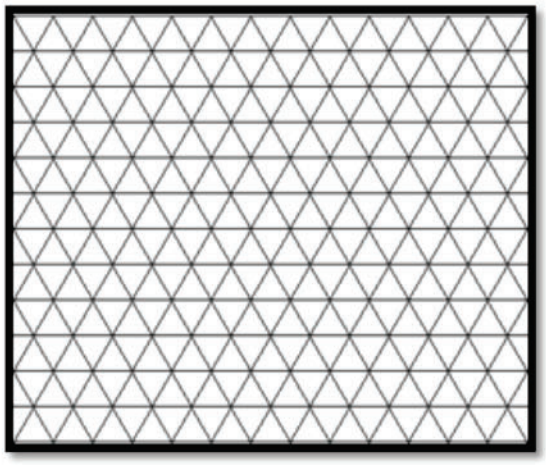
E = {a, e, i, o, u} and F = {p, q, r, s, t}

∴ E and F are equivalent sets because both have 5 elements in their set.

Q. 5 A. State whether any given set is finite or infinite:

A = Set of all triangles in a plane.

Answer :

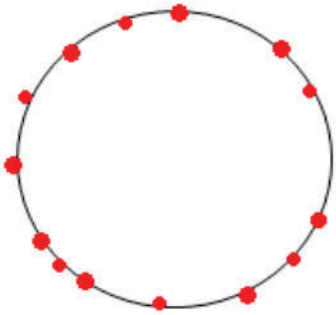


The set of all triangles in a plane is an infinite set because in a plane there is an infinite number of triangles.

Q. 5 B. State whether any given set is finite or infinite:

B = Set of all points on the circumference of a circle.

Answer :



There are infinite numbers of points on the circumference of the circle.

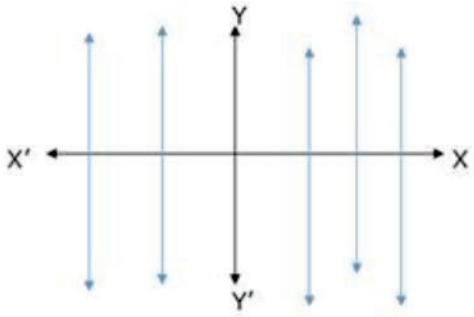
so the set will have infinite elements.

So, the given set is infinite.

Q. 5 C. State whether any given set is finite or infinite:

C = set of all lines parallel to the y-axis

Answer :



There are infinite lines parallel to y-axis,

so the set will have infinite elements.

So, the given set is infinite.

Q. 5 D. State whether any given set is finite or infinite:

D = set of all leaves on a tree

Answer : Here, the set is finite because infinite means never-ending.

Definitely, number will be huge but by definition, it has to be finite.

Q. 5 E. State whether any given set is finite or infinite:

E = set of all positive integers greater than 500

Answer : Positive Integers = 0, 1, 2, 3, …500

Positive Integers greater than 500 = 501, 502, 503, …

There are infinite positive integers which are greater than 500.

So, the given set is infinite.

Q. 5 F. State whether any given set is finite or infinite:

F = {x ∈ R: 0 < x < 1].

Answer : R means set of Real numbers

Real numbers include both rational and irrational numbers

Real numbers between 0 and 1 are infinite.

So, the given set is infinite.

Q. 5 G. State whether any given set is finite or infinite:

G = {x ∈ Z: x < 1].

Answer : Integers = -3, -2, -1, 0, 1, 2, 3, …

Integers less than 1 (x < 1) = …-4, -3, -2, -1, 0

There are infinite integers which are less than 1.

∴ the given set is infinite.

Q. 5 H. State whether any given set is finite or infinite:

H = {x ∈ Z: –15 < x < 15].

Answer : Integers = -3, -2, -1, 0, 1, 2, 3, …

The integers lies between -15 and 15 are finite.

∴ the given set is finite.

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Q. 5 I. State whether any given set is finite or infinite:

J = {x : x ∈ N and x is prime}.

Answer : The given set is the set of all prime numbers and since the set of prime numbers is infinite. Hence, the given set is infinite.

Q. 5 J. State whether any given set is finite or infinite:

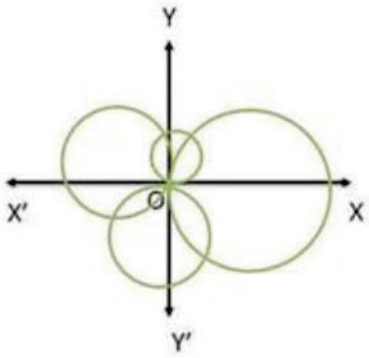
K = {x : x ∈ N and x is prime}.

Answer : The given set is the set of all prime numbers and since the set of prime numbers is infinite. Hence, the given set is infinite.

Q. 5 K. State whether any given set is finite or infinite:

L = set of all circles passing through the origin (0, 0)

Answer :



Infinitember of circles can pass through the origin, so the set will have infinite elements.

So, the given set is infinite

Q. 6. Rewrite the following statements using the set notation:

(i) a is an element of set A.

(ii) b is not an element of A.

(iii) A is an empty set and B is a nonempty set.

(iv) A number of elements in A is 6.

(v) 0 is a whole number but not a natural number.

Answer : (i) Given: a is an element of set A

this means $a \in A$

(ii) Given: b is not an element of A

this means $b \notin A$

(iii) Given: A is an empty set

and B is a non – empty set

this means $A = \phi$

and $B \neq \phi$

(iv) Given: In set A, total number of elements is 6

This means, $|A| = 6$

(v) Given: 0 is a whole number but not a natural number

This means $0 \in W$ but $0 \notin N$

Exercise 1C

Q. 1 A. State in each case whether $A \subset B$ or $A \not\subset B$.

$A = \{0, 1, 2, 3,\}$, $B = \{1, 2, 3, 4, 5\}$

Answer : $A \not\subset B$

Explanation: $A \not\subset B$ since $0 \in A$ and $0 \notin B$.

Q. 1 B. State in each case whether $A \subset B$ or $A \not\subset B$.

$A = \phi$, $B = \{0\}$

Answer : $A \subset B$

Explanation: A is a null set. Since, ϕ is a subset of every set therefore $A \subset B$.

Q. 1 C. State in each case whether $A \subset B$ or $A \not\subset B$.

$A = \{1, 2, 3,\}$, $B = \{1, 2, 4\}$

Answer : $A \not\subset B$

Explanation: $A \not\subset B$ since $3 \in A$ and $3 \notin B$.

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Q. 1 D. State in each case whether $A \subset B$ or $A \not\subset B$.

$A = \{x : x \in Z, x^2 = 1\}$, $B = \{x : x \in N, x^2 = 1\}$

Answer : $A \not\subset B$

Explanation: we have, $A = \{-1, 1\}$ and $B = \{1\}$

Since, $-1 \in A$ and $-1 \notin B$ thus $A \not\subset B$.

Q. 1 E. State in each case whether $A \subset B$ or $A \not\subset B$.

$A = \{x : x$ is an even natural number,$\}$, $B = \{x : x$ is an integer$\}$

Answer : $A \subset B$

Explanation: we have, $A = \{2,4,6,8,...\}$ and $B = \{. . ., -3, -2, -1, 0, 1, 2, 3, . . .\}$. since, even natural numbers are also integers, we observe that elements of A belongs to B.

Thus , $A \subset B$.

Q. 1 F. State in each case whether A ⊂ B or A ⊄ B.

A = {x : x is an integer}, B = {x: x is a rational number}

Answer : A = {….-2, -1, 0, 1, 2, 3….}

B = {-∞, ……..0, ……∞ }

A ⊂ B as integers are contained in rational numbers.

Q. 1 G State in each case whether A ⊂ B or A ⊄ B.

A = {x : x is a real number,}, B = {x : x is a complex number}

Answer : A ⊂ B

Explanation: we have, A = set of real numbers and B = set of complex numbers, a combination of the real and imaginary number in the form of a+ib, where a and b are real, and i is imaginary.

Since, any real number can be expressed as complex number, A ⊂ B.

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Q. 1 H. State in each case whether A ⊂ B or A ⊄ B.

A = {x : x is an isosceles triangle in the plane}, B = {x : x is an equilateral triangle in the same plane}

Answer : A ⊄ B

Explanation: since all isosceles triangles are not equilateral triangles. Therefore set of isosceles triangle is not contained in the set of equilateral triangle.

Q. 1 I. State in each case whether A ⊂ B or A ⊄ B.

A = {x : x is a square in a plane}, B = {x : x is a rectangle in the same plane}

Answer : A ⊂ B

Explanation: Set of squares is a subset of set of rectangles since all squares are rectangles.

Q. 1 J. State in each case whether A ⊂ B or A ⊄ B.

A = {x : x is a triangle in a plane}, B = {x : x is a rectangle in the same plane}

Answer : A ⊄ B