पु॰ना International School

Shree Swaminarayan Gurukul, Zundal

Grade – 9

MATHS

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INDEX

CHAPTER NO. – 1

CHAPTER NAME – Number Systems.

KEY POINTS TO REMEMBER :

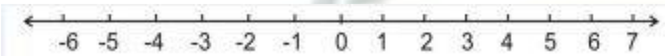
1 Rational Numbers

2 Irrational Numbers

3 Real Numbers and their Decimal Expansions

4 Operations on Real Numbers

5 Laws of Exponents for Real Numbers



- Natural numbers are : 1, 2, 3, …………….. denoted by N.
- Whole numbers are : 0, 1, 2, 3, ……………… denoted by W.
- Integers : ……. -3, -2, -1, 0, 1, 2, 3, ……………… denoted by Z.
- Rational numbers - All the numbers which can be written in the form p/q are called rational numbers where p and q are integers and $q \neq 0$.
- Every integer p is also a rational number, can be written as p/1.
- Irrational numbers - A number is called irrational, if it cannot be written in the form p/q where p and q are integers and $q \neq 0$.
- The decimal expansion of a rational number is either terminating or non terminating recurring. Thus we say that a number whose decimal expansion is either terminating or non terminating recurring is a rational number.
- Terminating decimals: The rational numbers with a finite decimal part or for which the long division terminates after a finite number of steps are known as finite or terminating decimals.
- Non-Terminating decimals: The rational numbers with an infinite decimal part or for which the long division does not terminate even after an infinite number of steps are known as infinite or non-terminating decimals
- The decimal expansion of an irrational number is non terminating non recurring.
- All the rational numbers and irrational numbers taken together make a collection of real numbers.
- A real number is either rational or irrational.
- If r is rational and s is irrational then r+s, r–s, rxs are always irrational numbers but r/s may be rational or irrational.
- If n is a natural number other than a perfect square, then $\sqrt{n}$ is a irrational number.
- Negative of an irrational number is an irrational number.
- There is a real number corresponding to every point on the number line. Also, corresponding to every real number there is a point on the number line.
- Every irrational number can be represented on a number line using Pythagoras theorem.

- For every positive real number x, $\sqrt{x}$ can be represented by a point on the number line by using the following steps:

1. Obtain all positive real numbers x (say).
2. Draw a line and mark a point P on it.
3. Make a point Q on the line such that PQ = x units.
4. From point Q mark a distance of 1 unit and mark the new point as R.
5. Find the mid-point of PR and mark the point as O.
6. Draw a circle with centre O and radius OR.
7. Draw a line perpendicular to PR passing through Q and intersecting the semi-circle at S. Length QS is equal to

CHAPTER 1

Number Systems

(Ex. 1.1)

1. Is zero a rational number? Can you write it in the form $\frac{p}{q}$, where *p* and *q* are integers and $q \neq 0$?

Ans. Consider the definition of a rational number.

A rational number is the one that can be written in the form of $\frac{p}{q}$, where *p* and *q* are integers and $q \neq 0$.

Zero can be written as $\frac{0}{1}, \frac{0}{2}, \frac{0}{3}, \frac{0}{4}, \frac{0}{5}$......

So, we arrive at the conclusion that 0 can be written in the form of , where *q* is any integer. $\frac{p}{q}$

Therefore, zero is a rational number.

2. Find six rational numbers between 3 and 4.

Ans. We know that there are infinite rational numbers between any two numbers.

A rational number is the one that can be written in the form of $\frac{p}{q}$, where *p* and *q* are

Integers and .

We know that the numbers $3.1, 3.2, 3.3, 3.4, 3.5$ and 3.6 all lie between 3 and 4.

We need to rewrite the numbers in $\frac{p}{q}$ form to get the rational numbers between 3 and 4.

So, after converting, we get $\frac{31}{10}, \frac{32}{10}, \frac{33}{10}, \frac{34}{10}, \frac{35}{10}$ and $\frac{36}{10}$.

We can further convert the rational numbers $\frac{32}{10}, \frac{34}{10}, \frac{35}{10}$ and $\frac{36}{10}$ into lowest fractions.

On converting the fractions into lowest fractions, we get $\frac{16}{5}, \frac{17}{5}, \frac{7}{2}$ and $\frac{18}{5}$.

Therefore, six rational numbers between 3 and 4 are $\frac{31}{10}, \frac{16}{5}, \frac{33}{10}, \frac{17}{5}, \frac{7}{2}$ and $\frac{18}{5}$.

3. Find five rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$.

Ans. We know that there are infinite rational numbers between any two numbers.

A rational number is the one that can be written in the form of $\frac{p}{q}$, where *p* and *q* are Integers and $q \neq 0$.

We know that the numbers $\frac{3}{5}$ and $\frac{4}{5}$ can also be written as 0.6 and 0.8.

We can conclude that the numbers $0.61, 0.62, 0.63, 0.64$ and 0.65 all lie between 0.6 and 0.8

We need to rewrite the numbers $0.61, 0.62, 0.63, 0.64$ and 0.65 in $\frac{p}{q}$ form to get the rational numbers between 3 and 4.

So, after converting, we get $\frac{61}{100}, \frac{62}{100}, \frac{63}{100}, \frac{64}{100}$ and $\frac{65}{100}$.

.

We can further convert the rational numbers $\frac{62}{100}, \frac{64}{100}$ and $\frac{65}{100}$ into lowest fractions.

On converting the fractions, we get $\frac{31}{50}, \frac{16}{25}$ and $\frac{13}{20}$.

Therefore, six rational numbers between 3 and 4 are $\frac{61}{100}, \frac{31}{50}, \frac{63}{100}, \frac{16}{25}$ and $\frac{13}{50}$.

4. State whether the following statements are true or false. Give reasons for your answers.

(i) Every natural number is a whole number.

(ii) Every integer is a whole number.

(iii) Every rational number is a whole number.

Ans. (i) Consider the whole numbers and natural numbers separately.

We know that whole number series is $0, 1, 2, 3, 4, 5.....$.

We know that natural number series is $1, 2, 3, 4, 5.....$.

So, we can conclude that every number of the natural number series lie in the whole number series.

Therefore, we conclude that, yes every natural number is a whole number.

(ii) Consider the integers and whole numbers separately.

We know that integers are those numbers that can be written in the form of $\frac{p}{q}$, where q

Now, considering the series of integers, we have $.... -4, -3, -2, -1, 0, 1, 2, 3, 4.....$.

We know that whole number series is $0, 1, 2, 3, 4, 5.....$.

We can conclude that all the numbers of whole number series lie in the series of integers.

But every number of series of integers does not appear in the whole number series.

Therefore, we conclude that every integer is not a whole number.

(iii) Consider the rational numbers and whole numbers separately.

We know that rational numbers are the numbers that can be written in the form , where $q \neq 0$ $.\frac{p}{q}$

We know that whole number series is $0, 1, 2, 3, 4, 5.....$.

We know that every number of whole number series can be written in the form of $\frac{p}{q}$ as $q \neq 0$ $\frac{0}{1}, \frac{1}{1}, \frac{2}{1}, \frac{3}{1}, \frac{4}{1}, \frac{5}{1}.....$.

We conclude that every number of the whole number series is a rational number. But, every rational number does not appear in the whole number series.

Therefore, we conclude that every rational number is not a whole number.

Number Systems

(Ex. 1.2)

5. State whether the following statements are true or false. Justify your answers.

(i) Every irrational number is a real number.

(ii) Every point on the number line is of the form $\sqrt{m}$, where *m* is a natural number. (iii) Every real number is an irrational number.

Ans. (i) Consider the irrational numbers and the real numbers separately.

We know that irrational numbers are the numbers that cannot be converted in the form $\frac{p}{q}$, where *p* and *q* are integers and $q \neq 0$.

We know that a real number is the collection of rational numbers and irrational numbers.

Therefore, we conclude that, yes every irrational number is a real number.

(ii)False, Consider a number line. We know that on a number line, we can represent negative as well as positive numbers.

We know that we cannot get a negative number after taking square root of any number.

Therefore, we conclude that not every number point on the number line is of the form $\sqrt{m}$, where *m* is a natural number.

(iii)False, Consider the irrational numbers and the real numbers separately.

We know that irrational numbers are the numbers that cannot be converted in the form $\frac{p}{q}$, where *p* and *q* are integers and $q \neq 0$.

We know that a real number is the collection of rational numbers and irrational numbers.

So, we can conclude that every irrational number is a real number. But every real number is not an irrational number.

Therefore, we conclude that, every real number is not a rational number.

(iv) Are the square roots of all positive integers irrational ? If not, give an example of the square root of a number that is a rational number.

Ans. We know that square root of every positive integer will not yield an integer.

We know that $\sqrt{4}$ is 2, which is an integer. But, $\sqrt{7}$ or $\sqrt{10}$ will give an irrational number.

Therefore, we conclude that square root of every positive integer is not an irrational number.

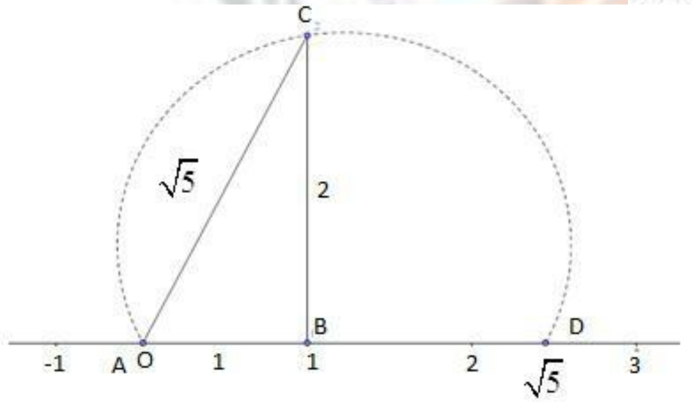
(iii) Show how $\sqrt{5}$ can be represented on the number line. Ans.

According to the Pythagoras theorem, we can conclude that

$$\left(\sqrt{5}\right)^2 = (2)^2 + (1)^2$$.

We need to draw a line segment *AB* of 1 unit on the number line. Then draw a straight line segment *BC* of 2 units. Then join the points *C* and *A*, to form a line segment *BC*.

Then draw the arc *ACD*, to get the number $\sqrt{5}$ on the number line.



Number Systems
(Ex. 1.3)

6. Write the following in decimal form and say what kind of decimal expansion each has:

(i) $\frac{36}{100}$

(ii) $\frac{1}{11}$

(iii) $4\frac{1}{8}$

(iv) $\frac{3}{13}$

(v) $\frac{2}{11}$

(vi) $\frac{329}{400}$

Ans. (i) $\frac{36}{100}$

On dividing 36 by 100, we get

$$
\begin{array}{r}
0.36 \\
100\,)\;\;36 \\
\underline{-0} \\
360 \\
\underline{-300} \\
600 \\
\underline{-600} \\
\underline{0}
\end{array}
$$

Therefore, we conclude that $\frac{36}{100} = 0.36$, which is a terminating decimal.

(ii) $\frac{1}{11}$

On dividing 1 by 11, we get

$$
\begin{array}{r|l}
 & 0.0909.... \\
11 & 1 \\
 & -0 \\
 & 10 \\
 & -0 \\
 & 100 \\
 & -99 \\
 & 10 \\
 & -0 \\
 & 100 \\
 & -99 \\
 & 1
\end{array}
$$

We can observe that while dividing 1 by 11, we got the remainder as 1, which will continue to be 1.

Therefore, we conclude that $\frac{1}{11} = 0.0909.....$ or $\frac{1}{11} = 0.\overline{09}$, which is a non-terminating repeating decimal.

(iii) $4\frac{1}{8} = \frac{33}{8}$

On dividing 33 by 8, we get

$$
\begin{array}{r|l}
 & 4.125 \\
8 & 33 \\
 & -32 \\
 & 10 \\
 & -8 \\
 & 20 \\
 & -16 \\
 & 40 \\
 & -40 \\
 & 0
\end{array}
$$

We can observe that while dividing 33 by 8, we got the remainder as 0.

Therefore, we conclude that $4\frac{1}{8}=\frac{33}{8}=4.125$, which is a terminating decimal.

(iv) $\frac{3}{13}$

On dividing 3 by 13, we get

$$
\begin{array}{r}
0.230769\ldots \\
13\overline{)\quad 3} \\
\underline{-0} \\
30 \\
\underline{-26} \\
40 \\
\underline{-39} \\
10 \\
\underline{-0} \\
100 \\
\underline{-91} \\
90 \\
\underline{-78} \\
120 \\
\underline{-117} \\
\underline{3}
\end{array}
$$

We can observe that while dividing 3 by 13 we got the remainder as 3, which will continue to be 3 after carrying out 6 continuous divisions.

Therefore, we conclude that $\frac{3}{13}=0.230769.....$ or $\frac{3}{13}=0.\overline{230769}$, which is a non-terminating repeating decimal.

(v) $\frac{2}{11}$

On dividing 2 by 11, we get

$$
\begin{array}{r}
0.1818.... \\
11\overline{)\quad 2} \\
\underline{-0} \\
20 \\
\underline{-11} \\
90 \\
\underline{-88} \\
20 \\
\underline{-11} \\
90 \\
\underline{-88} \\
\underline{2}
\end{array}
$$

We can observe that while dividing 2 by 11, first we got the remainder as 2 and then 9, which will continue to be 2 and 9 alternately.

Therefore, we conclude that $\frac{2}{11} = 0.1818.....$ or $\frac{2}{11} = 0\overline{18}$, which is a non-terminating repeating decimal.

(vi) $\frac{329}{400}$

On dividing 329 by 400, we get

$$
\begin{array}{r}
0.8225 \\
400\overline{)\quad 329} \\
\underline{-0} \\
3290 \\
\underline{-3200} \\
900 \\
\underline{-800} \\
1000 \\
\underline{-800} \\
2000 \\
\underline{-2000} \\
\underline{0}
\end{array}
$$

We can observe that while dividing 329 by 400, we got the remainder as 0.

Therefore, we conclude that $\frac{329}{400} = 0.8225$, which is a terminating decimal.

2. You know that $\frac{1}{7}=0.142857......$. Can you predict what the decimal expansions of $\frac{2}{7},\frac{3}{7},\frac{4}{7},\frac{5}{7},\frac{6}{7}$ are, without actually doing the long division? If so, how?

[Hint: Study the remainders while finding the value of $\frac{1}{7}$ carefully.]

Ans. We are given that $\frac{1}{7}=0.\overline{142857}$ or $\frac{1}{7}=0.142857.....$.

We need to find the values of $\frac{2}{7},\frac{3}{7},\frac{4}{7},\frac{5}{7}$ and $\frac{6}{7}$, without performing long division.

We know that, $\frac{2}{7},\frac{3}{7},\frac{4}{7},\frac{5}{7}$ and $\frac{6}{7}$ can be rewritten as $2\times\frac{1}{7},3\times\frac{1}{7},4\times\frac{1}{7},5\times\frac{1}{7}$ and $6\times\frac{1}{7}$.

On substituting value of $\frac{1}{7}$ as $0.142857.....$, we get

$$2\times\frac{1}{7}=2\times0.142857.....=0.285714.........$$

$$3\times\frac{1}{7}=3\times0.142857....=0.428571---------$$

$$4\times\frac{1}{7}=4\times0.142857...=0.571428--------$$

$$5\times\frac{1}{7}=5\times0.142857.....=0.714285\ -------$$

$$6\times\frac{1}{7}=6\times0.142857.....=0.857142--------$$

Therefore, we conclude that, we can predict the values of $\frac{2}{7},\frac{3}{7},\frac{4}{7},\frac{5}{7}$ and $\frac{6}{7}$, without performing long division, to get

$\frac{2}{7} = 0.\overline{285714}, \frac{3}{7} = 0.\overline{428571}, \frac{4}{7} = 0.\overline{571428}, \frac{5}{7} = 0.\overline{714285},$ and $\frac{6}{7} = 0.\overline{857142}$

3. Express the following in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

(v) $0.\overline{6}$

(vi) $0.4\overline{7}$

(vii) $0.\overline{001}$

Ans. Solution:

(i) $\text{Let } x = 0.\overline{6} \Rightarrow x = 0.6666.........(a)$

We need to multiply both sides by 10 to get

$10x = 6.6666..... \quad .....(b)$

We need to subtract (*a*)from (*b*), to get

$$\begin{array}{l} 10x = 6.6666..... \\ -x = 0.6666..... \\ \hline 9x = 6 \end{array}$$

We can also write $9x = 6$ as $x = \frac{6}{9}$ or $x = \frac{2}{3}$.

Therefore, on converting $0.\overline{6}$ in the $\frac{p}{q}$ form, we get the answer as $\frac{2}{3}$.

(ii) $\text{Let } x = 0.4\overline{7} \Rightarrow x = 0.47777.......(a)$

We need to multiply both sides by 10 to get

$10x = 4.7777.....(b)$

We need to subtract (a)from (b), to get

$$\begin{aligned} 10x &= 4.7777..... \\ -x &= 0.4777.... \\ \hline 9x &= 4.3 \end{aligned}$$

We can also write $9x = 4.3$ as $x = \frac{4.3}{9}$ or $x = \frac{43}{90}$.

Therefore, on converting $0.4\bar{7}$ in the $\frac{p}{q}$ form, we get the answer as $\frac{43}{90}$.

(iii) $\text{Let } x = 0.\overline{001} \Rightarrow x = 0.001001........(a)$

We need to multiply both sides by 1000 to get

$1000x = 1.001001.....$ $....(b)$

We need to subtract (a)from (b), to get

$$\begin{aligned} 1000x &= 1.001001..... \\ -x &= 0.001001.... \\ \hline 999x &= 1 \end{aligned}$$

We can also write $999x = 1$ as $x = \frac{1}{999}$.

Therefore, on converting $0.\overline{001}$ in the $\frac{p}{q}$ form, we get the answer as $\frac{1}{999}$.

4. Express $0.99999....$ in the form $\frac{p}{q}$. Are you surprised by your answer? Discuss why the answer makes sense with your teacher and classmates.

Ans. $\text{Let } x = 0.99999......(a)$

We need to multiply both sides by 10 to get

$10x = 9.9999......(b)$

We need to subtract (*a*)from (*b*), to get

$$\begin{array}{r} 10x = 9.99999..... \\ -x = 0.99999.... \\ \hline 9x = 9 \end{array}$$

We can also write $9x = 9$ as $x = \frac{9}{9}$ or $x = 1$.

Therefore, on converting $0.99999....$ in the $\frac{p}{q}$ form, we get the answer as 1.

Yes, at a glance we are surprised at our answer.

But the answer makes sense when we observe that 0.9999……… goes on forever. SO there is not gap between 1 and 0.9999……. and hence they are equal.

5. What can the maximum number of digits be in the recurring block of digits in the decimal expansion of $\frac{1}{17}$? Perform the division to check your answer.

Ans. We need to find the number of digits in the recurring block of $\frac{1}{17}$.

Let us perform the long division to get the recurring block of $\frac{1}{17}$.

We need to divide 1 by 17, to get

We can observe that while dividing 1 by 17 we got the remainder as 1, which will continue to be 1 after carrying out 16 continuous divisions.

Therefore, we conclude that

$\frac{1}{17} = 0.0588235294117647.....$ or $\frac{1}{17} = 0.\overline{0588235294117647}$, which is a non-terminating decimal and recurring decimal.

6. Look at several examples of rational numbers in the form $\frac{p}{q}$ ($q \neq 0$), where p and q are integers with no common factors other than 1 and having terminating decimal representations (expansions). Can you guess what property q must satisfy?

Ans. Solution:

Let us consider the examples of the form $\frac{p}{q}$ that are terminating decimals.

$\frac{5}{2} = 2.5$

$\frac{5}{4} = 1.25$

$\frac{2}{5} = 0.4$

$\frac{2}{10} = 0.2$

$\frac{5}{16} = 0.3125$

We can observe that the denominators of the above rational numbers have powers of 2, 5 or both.

Therefore, we can conclude that the property, which q must satisfy in $\frac{p}{q}$, so that the rational number $\frac{p}{q}$ is a terminating decimal is that q must have powers of 2, 5 or both.

$isnotequalto$

7. Write three numbers whose decimal expansions are non-terminating non-recurring.

Ans. The three numbers that have their expansions as non-terminating on recurring decimal are given below.

0.04004000400004….

0.07007000700007….

0.013001300013000013….

8. Find three different irrational numbers between the rational numbers $\frac{5}{7}$ and $\frac{9}{11}$.

Ans. Let us convert $\frac{5}{7}$ and $\frac{9}{11}$ into decimal form, to get

$\frac{5}{7} = 0.714285....$ and $\frac{9}{11} = 0.818181....$

Three irrational numbers that lie between $0.714285....$ and $0.818181....$ are:

0.73073007300073….

0.74074007400074….

0.76076007600076….

(iv) Classify the following numbers as rational or irrational:

(i) $\sqrt{23}$

(ii) $\sqrt{225}$

(iv) 0.3796

(v) 7.478478...

(vi) 1.101001000100001...

Ans. (i) $\sqrt{23}$

We know that on finding the square root of 23, we will not get an integer.

Therefore, we conclude that $\sqrt{23}$ is an irrational number.

(ii) $\sqrt{225}$

We know that on finding the square root of 225, we get 15, which is an integer.

Therefore, we conclude that $\sqrt{225}$ is a rational number.

(iii) 0.3796

We know that 0.3796 can be converted into $\frac{p}{q}$.

While, converting 0.3796 into $\frac{p}{q}$ form, we get

$$0.3796 = \frac{3796}{10000}.$$

The rational number $\frac{3796}{10000}$ can be converted into lowest fractions, to get $\frac{949}{2500}$.

We can observe that 0.3796 can be converted into a rational number.

Therefore, we conclude that 0.3796 is a rational number.

(iv) 7.478478….

We know that 7.478478…. is a non-terminating recurring decimal, which can be converted into $\frac{p}{q}$ form.

While, converting 7.478478…. into $\frac{p}{q}$ form, we get

$x = 7.478478.... \quad ....(a)$

$1000x = 7478.478478.......(b)$

While, subtracting (b) from (a), we get

$$\begin{array}{r} 1000x = 7478.478478.... \\ -x = \quad 7.478478.... \\ \hline 999x = 7471 \end{array}$$

We know that $999x = 7471$ can also be written as $x = \frac{7471}{999}$.

Therefore, we conclude that 7.478478…. is a rational number.

(v) 1.101001000100001....

We can observe that the number 1.101001000100001.... is a non-terminating on recurring decimal.

We know that non-terminating and non-recurring decimals cannot be converted into form. $\frac{p}{q}$

Therefore, we conclude that 1.101001000100001.... is an irrational number.

Number Systems

Ex. 1.4

7. Visualize 3.765 on the number line using successive magnification. Ans. We

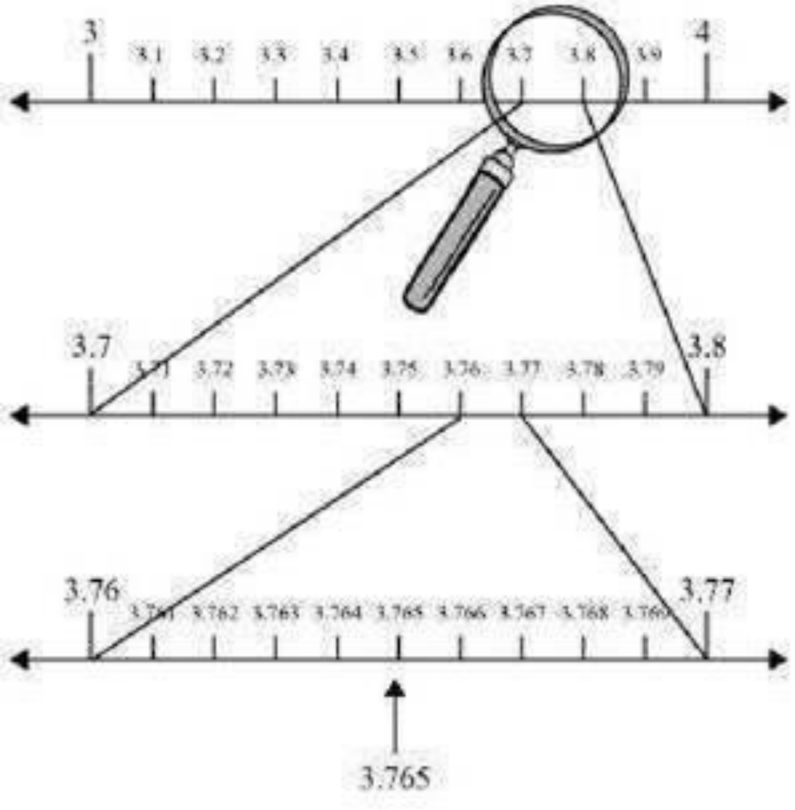
know that the number 3.765 will lie between 3.764 and 3.766. We know that the

numbers 3.764 and 3.766 will lie between 3.76 and 3.77. We know that the numbers

3.76 and 3.77 will lie between 3.7 and 3.8.

We know that the numbers 3.7 and 3.8 will lie between 3 and 4.

Therefore, we can conclude that we need to use the successive magnification, after locating numbers 3 and 4 on the number line.



2. Visualize $4.\overline{26}$ on the number line, up to 4 decimal places.

Ans. We know that the number $4.\overline{26}$ can also be written as $4.262....$.

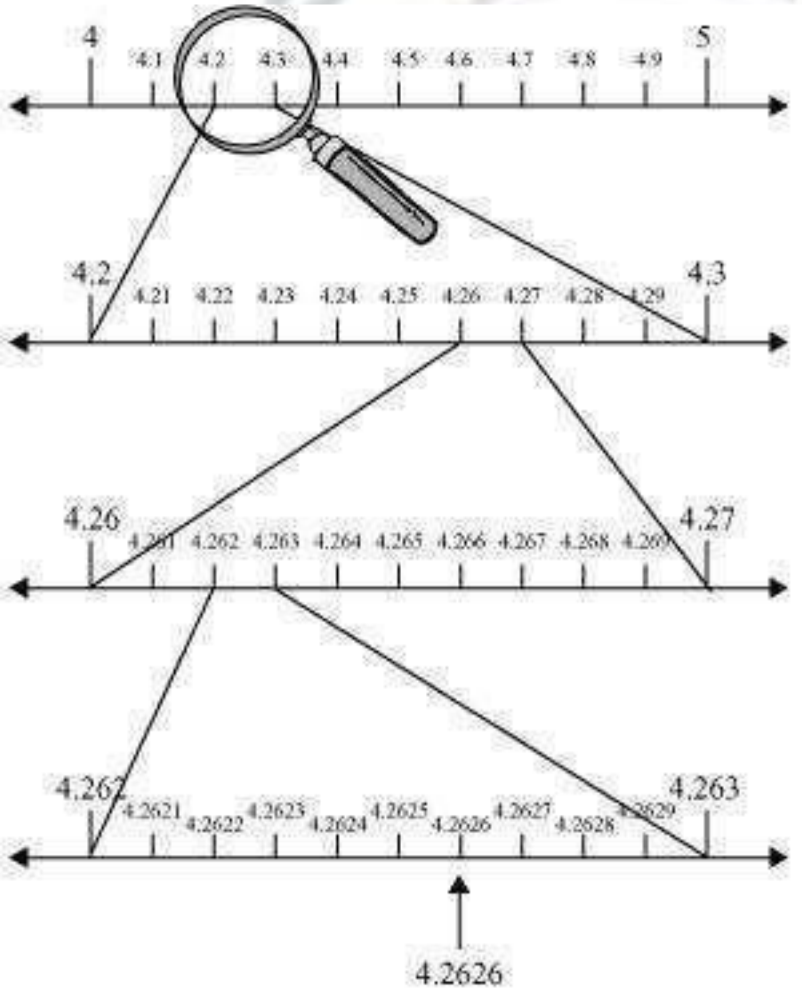
We know that the number $4.262....$ will lie between 4.261 and 4.263.

We know that the numbers 4.261 and 4.263 will lie between 4.26 and 4.27.

We know that the numbers 4.26 and 4.27 will lie between 4.2 and 4.3.

We know that the numbers 4.2 and 4.3 will lie between 4 and 5.

Therefore, we can conclude that we need to use the successive magnification, after locating numbers 4 and 5 on the number line.



Number Systems

Ex. 1.5

1. Classify the following numbers as rational or irrational:

(i) $2-\sqrt{5}$

(ii) $\left(3+\sqrt{23}\right)-\sqrt{23}$

(iii) $\frac{2\sqrt{7}}{7\sqrt{7}}$

(iv) $\frac{1}{\sqrt{2}}$

(v) 2π

Solutions:- (i) $2-\sqrt{5}$

We know that $\sqrt{5}=2.236....$, which is an irrational number.

$2-\sqrt{5}=2-2.236....$

$=-0.236....,$

which is also an irrational number.

Therefore, we conclude that $2-\sqrt{5}$ is an irrational number.

(ii) $\left(3+\sqrt{23}\right)-\sqrt{23}$

$\left(3+\sqrt{23}\right)-\sqrt{23}=3+\sqrt{23}-\sqrt{23}$

= 3

Therefore, we conclude that $\left(3+\sqrt{23}\right)-\sqrt{23}$ is a rational number.

(iii) $\frac{2\sqrt{7}}{7\sqrt{7}}$

We can cancel $\sqrt{7}$ in the numerator and denominator, as $\sqrt{7}$ is the common number in numerator as well as denominator, to get

$$\frac{2\sqrt{7}}{7\sqrt{7}} = \frac{2}{7}$$

Therefore, we conclude that $\frac{2\sqrt{7}}{7\sqrt{7}}$ is a rational number.

(iv) $\frac{1}{\sqrt{2}}$

We know that $\sqrt{2} = 1.414....$, which is an irrational number.

We can conclude that, when 1 is divided by $\sqrt{2}$, we will get an irrational number.

Therefore, we conclude that $\frac{1}{\sqrt{2}}$ is an irrational number.

(v) 2π

We know that $\pi = 3.1415....$, which is an irrational number.

We can conclude that 2π will also be an irrational number.

Therefore, we conclude that 2π is an irrational number.

8. Simplify each of the following expressions:

(i) $\left(3+\sqrt{3}\right)\left(2+\sqrt{2}\right)$

(ii) $\left(3+\sqrt{3}\right)\left(3-\sqrt{3}\right)$

(iii) $\left(\sqrt{5}+\sqrt{2}\right)^2$

(iv) $\left(5-\sqrt{2}\right)\left(5+\sqrt{2}\right)$

Ans. (i) $\left(3+\sqrt{3}\right)\left(2+\sqrt{2}\right)$

We need to apply distributive law to find value of $\left(3+\sqrt{3}\right)\left(2+\sqrt{2}\right)$.

$$\left(3+\sqrt{3}\right)\left(2+\sqrt{2}\right) = 3\left(2+\sqrt{2}\right)+\sqrt{3}\left(2+\sqrt{2}\right)$$

$$= 6+3\sqrt{2}+2\sqrt{3}+\sqrt{6}$$

Therefore, on simplifying $\left(3+\sqrt{3}\right)\left(2+\sqrt{2}\right)$, we get $6+3\sqrt{2}+2\sqrt{3}+\sqrt{6}$.

(ii) $\left(3+\sqrt{3}\right)\left(3-\sqrt{3}\right)$

We need to apply distributive law to find value of $\left(3+\sqrt{3}\right)\left(3-\sqrt{3}\right)$.

$$\left(3+\sqrt{3}\right)\left(3-\sqrt{3}\right)=3\left(3-\sqrt{3}\right)+\sqrt{3}\left(3-\sqrt{3}\right)$$
$$=9-3\sqrt{3}+3\sqrt{3}-3$$

Therefore, on simplifying $\left(3+\sqrt{3}\right)\left(3-\sqrt{3}\right)$, we get 6.

(iii) $\left(\sqrt{5}+\sqrt{2}\right)^2$

We need to apply the formula $(a+b)^2=a^2+2ab+b^2$ to find value of $\left(\sqrt{5}+\sqrt{2}\right)^2$.

$$\left(\sqrt{5}+\sqrt{2}\right)^2=\left(\sqrt{5}\right)^2+2\times\sqrt{5}\times\sqrt{2}+\left(\sqrt{2}\right)^2$$
$$=5+2\sqrt{10}+2$$
$$=7+2\sqrt{10}.$$

Therefore, on simplifying $\left(\sqrt{5}+\sqrt{2}\right)^2$, we get $7+2\sqrt{10}$.

(iv) $\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right)$

We need to apply the formula $(a-b)(a+b)=a^2-b^2$ to find value of $\left(\sqrt{5}+\sqrt{2}\right)^2$.

$$\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right)=\left(\sqrt{5}\right)^2-\left(\sqrt{2}\right)^2$$

=5-2=3

Therefore, on simplifying $\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right)$, we get 3.

3. Recall, π is defined as the ratio of the circumference (say *c*) of a circle to its diameter (say *d*). That is, $\pi=\frac{c}{d}$. This seems to contradict the fact that π is irrational. How will you resolve this contradiction?

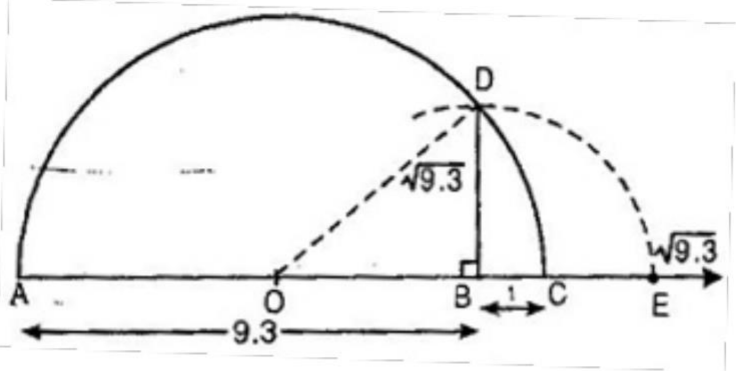
Ans. We know that when we measure the length of a line or a figure by using a scale or any device, we do not get an exact measurement. In fact, we get an approximate rational value. So, we are not able to realize that either circumference (c) or diameter(d) of a circle is irrational.

Therefore, we can conclude that as such there is not any contradiction regarding the value of π and we realize that the value of π is irrational.

4. Represent 9.3 on the number line.

Ans. Mark the distance 9.3 units from a fixed point A on a given line to obtain a point B such that AB = 9.3 units. From B mark a distance of 1 unit and call the new point as C. Find the mid-point of AC and call that point as O. Draw a semi-circle with centre O and radius OC = 5.15 units. Draw a line perpendicular to AC passing through B cutting the semi-circle at D.

Then BD =BE= $\sqrt{9.3}$ where point B is zero point of number line.



(viii) Rationalize the denominators of the following:

(i) $\frac{1}{\sqrt{7}}$

(ii) $\frac{1}{\sqrt{7}-\sqrt{6}}$

(iii) $\frac{1}{\sqrt{5}+\sqrt{2}}$

(iv) $\frac{1}{\sqrt{7}-2}$

Ans. (i) $\frac{1}{\sqrt{7}}$

We need to multiply the numerator and denominator of $\frac{1}{\sqrt{7}}$ by $\sqrt{7}$, to get

$$\frac{1}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{\sqrt{7}}{7}.$$

Therefore, we conclude that on rationalizing the denominator of $\frac{1}{\sqrt{7}}$, we get $\frac{\sqrt{7}}{7}$.

(ii) $\frac{1}{\sqrt{7}-\sqrt{6}}$

We need to multiply the numerator and denominator of $\frac{1}{\sqrt{7}-\sqrt{6}}$ by $\sqrt{7}+\sqrt{6}$, to get

$$\frac{1}{\sqrt{7}-\sqrt{6}} \times \frac{\sqrt{7}+\sqrt{6}}{\sqrt{7}+\sqrt{6}} = \frac{\sqrt{7}+\sqrt{6}}{\left(\sqrt{7}-\sqrt{6}\right)\left(\sqrt{7}+\sqrt{6}\right)}.$$

We need to apply the formula $(a-b)(a+b) = a^2 - b^2$ in the denominator to get

$$\frac{1}{\sqrt{7}-\sqrt{6}} = \frac{\sqrt{7}+\sqrt{6}}{\left(\sqrt{7}\right)^2 - \left(\sqrt{6}\right)^2}$$

$$= \frac{\sqrt{7}+\sqrt{6}}{7-6}$$

$$= \sqrt{7}+\sqrt{6}.$$

Therefore, we conclude that on rationalizing the denominator of $\frac{1}{\sqrt{7}-\sqrt{6}}$, we get $\sqrt{7}+\sqrt{6}$

.

(iii) $\frac{1}{\sqrt{5}+\sqrt{2}}$

We need to multiply the numerator and denominator of $\frac{1}{\sqrt{5}+\sqrt{2}}$ by $\sqrt{5}-\sqrt{2}$, to get

$$\frac{1}{\sqrt{5}+\sqrt{2}} \times \frac{\sqrt{5}-\sqrt{2}}{\sqrt{5}-\sqrt{2}} = \frac{\sqrt{5}-\sqrt{2}}{\left(\sqrt{5}+\sqrt{2}\right)\left(\sqrt{5}-\sqrt{2}\right)}.$$

We need to apply the formula $(a-b)(a+b)=a^2-b^2$ in the denominator to get

$$\frac{1}{\sqrt{5}+\sqrt{2}}=\frac{\sqrt{5}-\sqrt{2}}{(\sqrt{5})^2-(\sqrt{2})^2}$$

$$=\frac{\sqrt{5}-\sqrt{2}}{5-2}$$

$$=\frac{\sqrt{5}-\sqrt{2}}{3}.$$

Therefore, we conclude that on rationalizing the denominator of $\frac{1}{\sqrt{5}+\sqrt{2}}$, we get $\frac{\sqrt{5}-\sqrt{2}}{3}$.

(iv) $\frac{1}{\sqrt{7}-2}$

We need to multiply the numerator and denominator of $\frac{1}{\sqrt{7}-2}$ by $\sqrt{7}+2$, to get

$$\frac{1}{\sqrt{7}-2}\times\frac{\sqrt{7}+2}{\sqrt{7}+2}=\frac{\sqrt{7}+2}{(\sqrt{7}-2)(\sqrt{7}+2)}.$$

We need to apply the formula $(a-b)(a+b)=a^2-b^2$ in the denominator to get

$$\frac{1}{\sqrt{7}-2}=\frac{\sqrt{7}+2}{(\sqrt{7})^2-(2)^2}$$

$$=\frac{\sqrt{7}+2}{7-4}$$

$$=\frac{\sqrt{7}+2}{3}.$$

Therefore, we conclude that on rationalizing the denominator of $\frac{1}{\sqrt{7}-2}$, we get $\frac{\sqrt{7}+2}{3}$.

Number Systems

Ex. 1.6

9. Find:(i) $64^{\frac{1}{2}}$ **(ii)** $32^{\frac{1}{5}}$ **(iii)** $125^{\frac{1}{3}}$

Ans. (i) $64^{\frac{1}{2}}$

We know that $a^{\frac{1}{n}} = \sqrt[n]{a}$, where $a > 0$.

We conclude that $64^{\frac{1}{2}}$ can also be written as $\sqrt[2]{64} = \sqrt[2]{8 \times 8}$

$\sqrt[2]{64} = \sqrt[2]{8 \times 8} = 8.$

Therefore, the value of $64^{\frac{1}{2}}$ will be 8.

(ii) $32^{\frac{1}{5}}$

We know that $a^{\frac{1}{n}} = \sqrt[n]{a}$, where $a > 0$.

We conclude that $32^{\frac{1}{5}}$ can also be written as $\sqrt[5]{32} = \sqrt[2]{2 \times 2 \times 2 \times 2 \times 2}$

$\sqrt[5]{32} = \sqrt[2]{2 \times 2 \times 2 \times 2 \times 2} = 2$

Therefore, the value of $32^{\frac{1}{5}}$ will be 2.

(iii) $125^{\frac{1}{3}}$

We know that $a^{\frac{1}{n}} = \sqrt[n]{a}$, where $a > 0$.

We conclude that $125^{\frac{1}{3}}$ can also be written as $\sqrt[3]{125} = \sqrt[3]{5 \times 5 \times 5}$

$\sqrt[3]{125} = \sqrt[3]{5 \times 5 \times 5} = 5$

Therefore, the value of $125^{\frac{1}{3}}$ will be 5.

(ix) **Find:(i)** $9^{\frac{3}{2}}$ **(ii)** $32^{\frac{2}{5}}$ **(iii)** $16^{\frac{3}{4}}$ **(iv)** $125^{\frac{-1}{3}}$ **Ans. (i)** $9^{\frac{3}{2}}$

We know that $a^{\frac{1}{n}} = \sqrt[n]{a}$, where $a > 0$.

We conclude that $9^{\frac{3}{2}}$ can also be written as $\sqrt[2]{(9)^3} = \sqrt[2]{9 \times 9 \times 9} = \sqrt[2]{3 \times 3 \times 3 \times 3 \times 3 \times 3}$

$\sqrt[2]{(9)^3} = \sqrt[2]{3 \times 3 \times 3 \times 3 \times 3 \times 3}$

$= 3 \times 3 \times 3$

=27

Therefore, the value of $9^{\frac{3}{2}}$ will be 27.

(ii) $32^{\frac{2}{5}}$

We know that $a^{\frac{1}{n}} = \sqrt[n]{a}$, where $a > 0$.

We conclude that $32^{\frac{2}{5}}$ can also be written as $\sqrt[5]{(32)^2}$

$= \sqrt[5]{(2 \times 2 \times 2 \times 2 \times 2)(2 \times 2 \times 2 \times 2 \times 2)} = 2 \times 2$

= 4

Therefore, the value of $32^{\frac{2}{5}}$ will be 4.

(iii) $16^{\frac{3}{4}}$

We know that $a^{\frac{1}{n}} = \sqrt[n]{a}$, where $a > 0$.

We conclude that $16^{\frac{3}{4}}$ can also be written as $\sqrt[4]{(16)^3}$

$= \sqrt[4]{(2\times2\times2\times2)(2\times2\times2\times2)(2\times2\times2\times2)}$

$= 2\times2\times2$

= 8

Therefore, the value of $16^{\frac{3}{4}}$ will be 8.

(iv) $125^{\frac{-1}{3}}$

We know that $a^{-n} = \frac{1}{a^n}$

We conclude that $125^{\frac{-1}{3}}$ can also be written as $\frac{1}{125^{\frac{1}{3}}}$, or $\left(\frac{1}{125}\right)^{\frac{1}{3}}$.

We know that $a^{\frac{1}{n}} = \sqrt[n]{a}$, where $a > 0$.

We know that $\left(\frac{1}{125}\right)^{\frac{1}{3}}$ can also be written as $\sqrt[3]{\left(\frac{1}{125}\right)} = \sqrt[3]{\left(\frac{1}{5}\times\frac{1}{5}\times\frac{1}{5}\right)}$

$= \frac{1}{5}$.

Therefore, the value of $125^{\frac{-1}{3}}$ will be $\frac{1}{5}$.

(v) Simplify:

(i) $2^{\frac{2}{3}} \cdot 2^{\frac{1}{5}}$

(ii) $\left(\frac{1}{3^3}\right)^7$

(iii) $\frac{11^{\frac{1}{2}}}{11^{\frac{1}{4}}}$

(iv) $7^{\frac{1}{2}} \cdot 8^{\frac{1}{2}}$

Ans. (i) $2^{\frac{2}{3}} \cdot 2^{\frac{1}{5}}$

We know that $a^m \cdot a^n = a^{(m+n)}$.

We can conclude that $2^{\frac{2}{3}} \cdot 2^{\frac{1}{5}} = (2)^{\frac{2}{3}+\frac{1}{5}}$.

$2^{\frac{2}{3}} \cdot 2^{\frac{1}{5}} = (2)^{\frac{10+3}{15}} = (2)^{\frac{13}{15}}$

Therefore, the value of $2^{\frac{2}{3}} \cdot 2^{\frac{1}{5}}$ will be $(2)^{\frac{13}{15}}$.

(ii) $\left(\frac{1}{3^3}\right)^7$

We know that $(a^m)^n = a^{mn}$

$= \frac{1}{3^{3\times 7}} = \frac{1}{3^{21}} = 3^{-21}$

We conclude that $\left(\frac{1}{3^3}\right)^7$ can also be written as 3^{-21}

(iii) $\frac{11^{\frac{1}{2}}}{11^{\frac{1}{4}}}$

We know that $\frac{a^m}{a^n} = a^{m-n}$

We conclude that $\frac{11^{\frac{1}{2}}}{11^{\frac{1}{4}}} = 11^{\frac{1}{2}-\frac{1}{4}}$.

$$\frac{11^{\frac{1}{2}}}{11^{\frac{1}{4}}} = 11^{\frac{1}{2}-\frac{1}{4}} = 11^{\frac{2-1}{4}}$$

$$= 11^{\frac{1}{4}}$$

Therefore, the value of $\frac{11^{\frac{1}{2}}}{11^{\frac{1}{4}}}$ will be $11^{\frac{1}{4}}$.

(iv) $7^{\frac{1}{2}} \cdot 8^{\frac{1}{2}}$

We know that $a^m \cdot b^m = (a \times b)^m$.

We can conclude that $7^{\frac{1}{2}} \cdot 8^{\frac{1}{2}} = (7 \times 8)^{\frac{1}{2}}$.

$$7^{\frac{1}{2}} \cdot 8^{\frac{1}{2}} = (7 \times 8)^{\frac{1}{2}} = (56)^{\frac{1}{2}}$$

Therefore, the value of $7^{\frac{1}{2}} \cdot 8^{\frac{1}{2}}$ will be $(56)^{\frac{1}{2}}$.

SUBJECT : MATHS

CHAP - 1

Std : 9th

WORK-SHEET

1 The absolute value of | - 23 | is
(A) - 23 (B) 23 (C) 0 (D) None

2 The smallest prime number is
(A) 0 (B) 2 (C) 1 (D) None

3 The smallest whole number is
(A) 0 (B) 2 (C) 1 (D) None

SOLVE

4. Find six rational numbers between 3 and 4

5 Locate $\sqrt{2}$ on the number line

6 TRUE OR FALSE

(i) Every integer is a rational number
(ii) Every rational number is a integer.
(iii) Every whole number is a Natural number
(iv) Every integer is a whole number

SOLVE

1. Express 3. 142678 in the form $\frac{p}{q}$
2. Visualize 3.765 on the number line, using successive magnification.

Notes
CHAPTER – 3
COORDINATE GEOMETRY

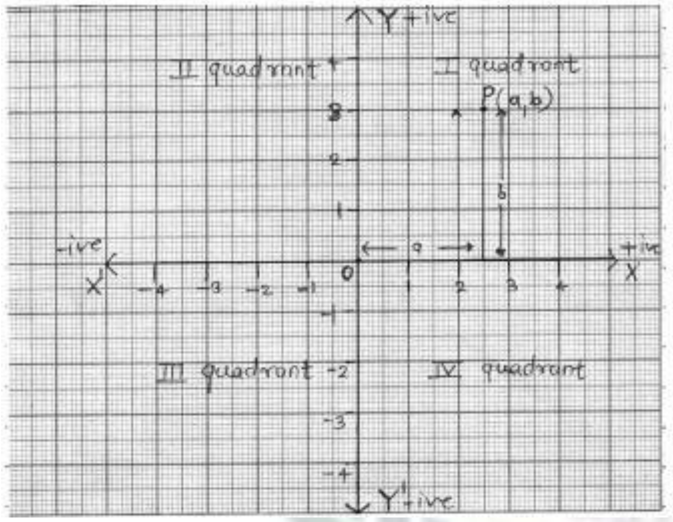
1. Cartesian System

2. Plotting a Point in the Plane with given Coordinates

Coordinate Geometry : The branch of mathematics in which geometric problems are solved through algebra by using the coordinate system is known as coordinate geometry.

Coordinate System

Coordinate axes: The position of a point in a plane is determined with reference to two fixed mutually perpendicular lines, called the coordinate axes.



In this system, position of a point is described by ordered pair of two numbers.

Quadrants: The coordinate axes divide the plane into four parts which are known as quadrants.

Ordered pair : A pair of numbers a and b listed in a specific order with 'a' at the first place and 'b' at the second place is called an ordered pair (a,b)

Note that $(a, b) \neq (b, a)$

Thus (2,3) is one ordered pair and (3,2) is another ordered pair.

In given figure O is called origin.

The horizontal line

XOX' is called the x-axis.

The vertical line YOY' is called the y-axis.

P(a, b) be any point in the plane. 'a' the first number denotes the distance of point from y - axis and 'b' the second number denotes the distance of point from x-axis.

a - X - coordinate | abscissa of P.

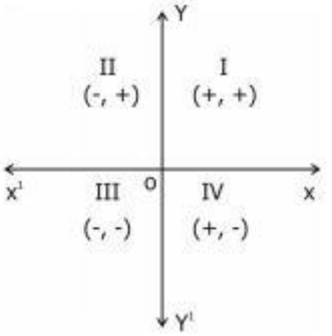
b - Y - coordinate | ordinate of P.

The point of intersection of the coordinate axes is called the **origin**.

The coordinates of origin are (0, 0)

Every point on the x-axis is at a distance o unit from the x -axis. So its ordinate is 0.

Every point on the y-axis is at a distance of unit from the y -axis. So, its abscissa is 0.



Note : Any point lying on x - axis or y - axis does not lie in any quadrant.

The sign of coordinates (x, y) of a point in various quadrants are as given below:

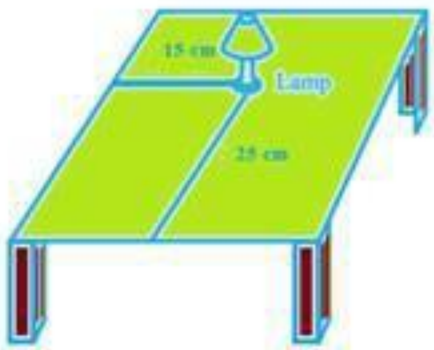
Quadrant	Coordinates	
○	x	y
I	+	+
II	-	+
III	-	-
IV	+	-

CHAPTER 3

Coordinate Geometry (Ex. 3.1)

1. How will you describe the position of a table lamp on your study table to another person?

Ans. Let us consider the given below figure of a study stable, on which a study lamp is placed.



Let us consider the lamp on the table as a point and the table as a plane. From the figure, we can conclude that the table is rectangular in shape, when observed from the top. The table has a short edge and a long edge.

Let us measure the distance of the lamp from the shorter edge and the longer edge. Let us assume that the distance of the lamp from the shorter edge is 15 cm and from the longer edge, its 25 cm.

Therefore, we can conclude that the position of the lamp on the table can be described in two ways depending on the order of the axes as $(15, 25)$ or $(25, 15)$.

2. (Street Plan): A city has two main roads which cross each other at the centre of the city. These two roads are along the North-South direction and East-West direction.

All the other streets of the city run parallel to these roads and are 200 m apart. There are 5 streets in each direction. Using 1cm = 200 m, draw a model of the city on your notebook. Represent the roads/streets by single lines.

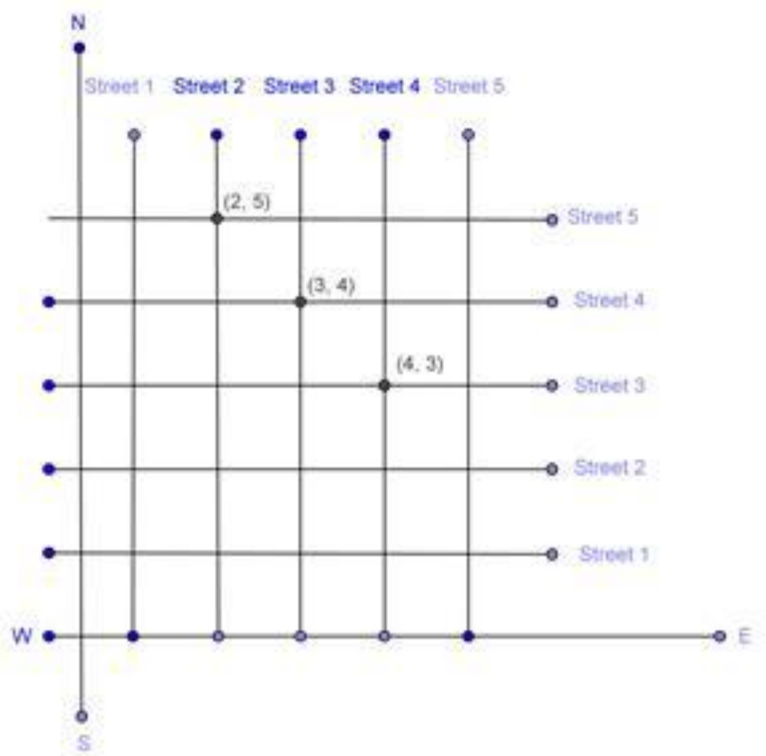
There are many cross- streets in your model. A particular cross-street is made by two streets, one running in the North - South direction and another in the East – West direction. Each cross street is referred to in the following manner: If the 2nd street running in the North - South direction and 5th in the East - West direction meet at some crossing, then we will call this cross-street (2, 5). Using this convention, find:

(i) how many cross - streets can be referred to as (4, 3).

(ii) how many cross - streets can be referred to as (3, 4).

Ans. We need to draw two perpendicular lines as the two main roads of the city that cross each other at the center and let us mark it as N-S and E-W. Let us take the scale as 1 cm = 200m.

We need to draw five streets that are parallel to both the main roads, to get the given below figure.



(i) From the figure, we can conclude that only one point have the coordinates as (4, 3). Therefore, we can conclude that only one cross - street can be referred to as (4, 3).

(ii) From the figure, we can conclude that only one point have the coordinates as (3, 4). Therefore, we can conclude that only one cross - street can be referred to as (3, 4).

Coordinate Geometry
Ex. 3.2

1. Write the answer of each of the following questions:

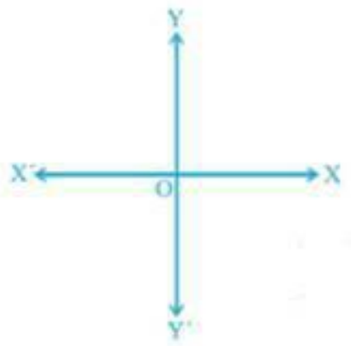
(i) **What is the name of horizontal and the vertical lines drawn to determine the position of any point in the Cartesian plane ?**

(ii) **What is the name of each part of the plane formed by these two lines ?**

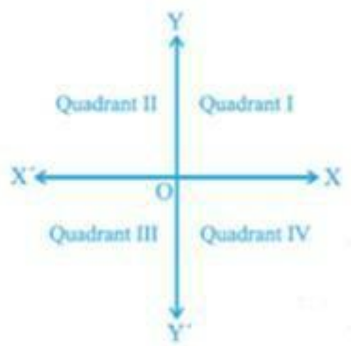
(iii) **Write the name of the point where these two lines intersect.**

Ans. (i) The horizontal line that is drawn to determine the position of any point in the Cartesian plane is called as ***x*-axis**.

The vertical line that is drawn to determine the position of any point in the Cartesian plane is called as ***y*-axis**.



(iii) The name of each part of the plane that is formed by *x*-axis and *y*-axis is called as **quadrant**.



(iii) The point, where the *x*-axis and the *y*-axis intersect is called as **origin**.

2. See Fig.3.14, and write the following:

(i) The coordinates of B.

(ii) The coordinates of C.

(iii) The point identified by the coordinates (–3, –5)

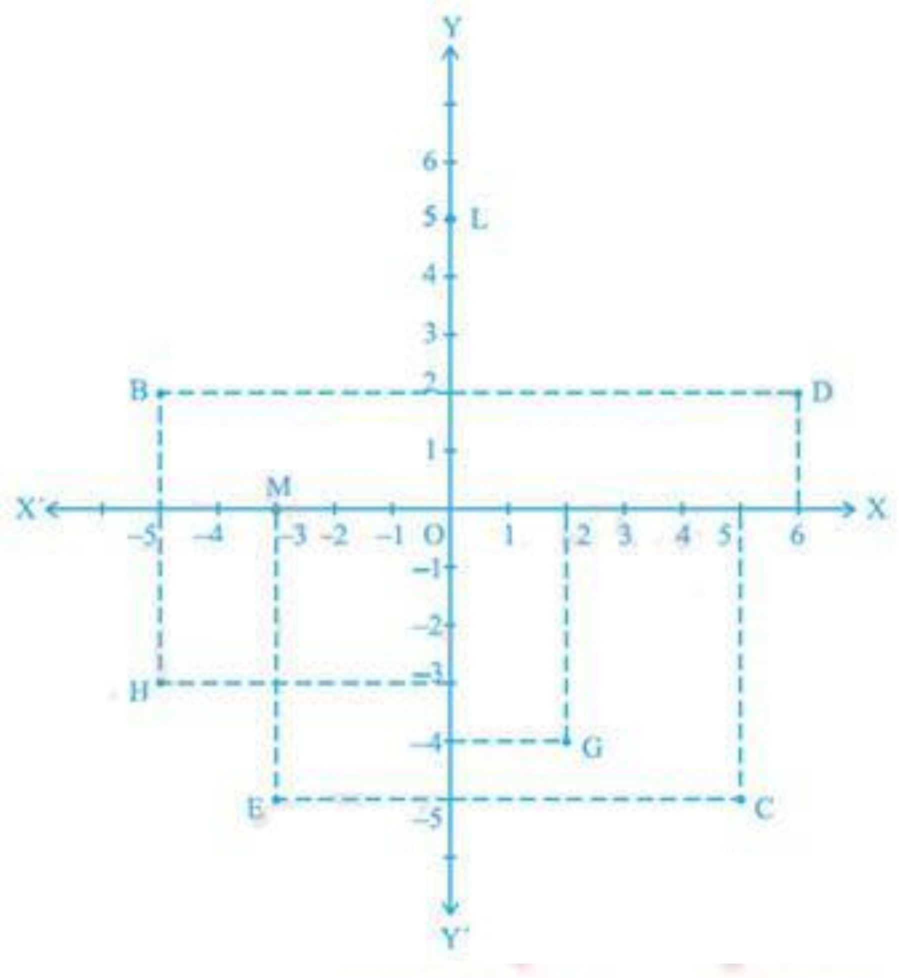
(iv) The point identified by the coordinates (2, – 4).

(v) The abscissa of the point D.

(vi) The ordinate of the point H.

(vii) The coordinates of the point L.

(viii) The coordinates of the point M.



Ans. We need to consider the given below figure to answer the following questions.

(i) The coordinates of point *B* in the above figure is the distance of point *B* from *x*-axis and *y*-axis.

Therefore, we can conclude that the coordinates of point *B* are (-5, 2).

(ii) The coordinates of point *C* in the above figure is the distance of point *C* from *x*-axis and *y*-axis.

Therefore, we can conclude that the coordinates of point *C* are (5, -5).

(iii) The point that represents the coordinates (-3, -5) is *E*.

(iv) The point that represents the coordinates (2, - 4) is *G*.

(v) The abscissa of point *D* in the above figure is the distance of point *D* from the *y*-axis. Therefore, we can conclude that the abscissa of point *D* is 6.

(vi) The ordinate of point *H* in the above figure is the distance of point *H* from the *x*-axis. Therefore, we can conclude that the abscissa of point *H* is -3.

(vii) The coordinates of point *L* in the above figure is the distance of point *L* from *x*-axis and *y*-axis. Therefore, we can conclude that the coordinates of point *L* are (0, 5).

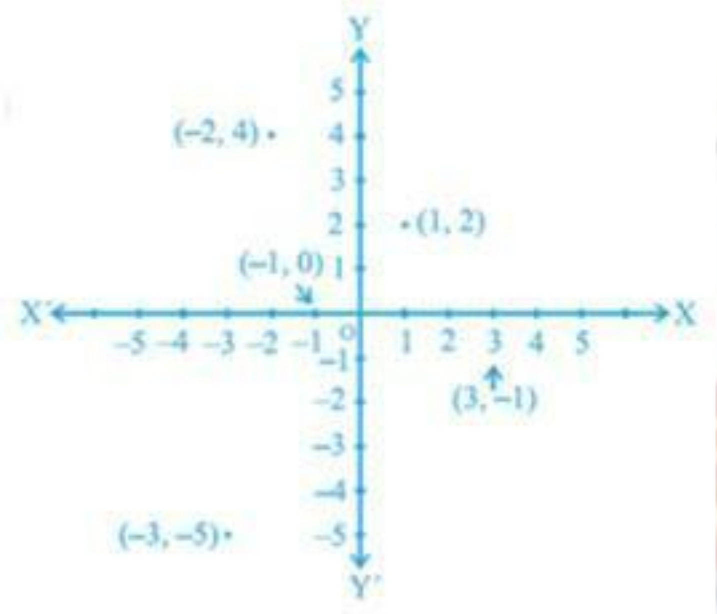
(viii) The coordinates of point *M* in the above figure is the distance of point *M* from *x*-axis and *y*-axis. Therefore, we can conclude that the coordinates of point *M* are (-3, 0).

Coordinate Geometry
Ex. 3.3

1. **In which quadrant or on which axis do each of the points (- 2, 4), (3, - 1), (- 1, 0), (1, 2) and (- 3, - 5) lie ? Verify your answer by locating them on the Cartesian plane.**

Ans. We need to determine the quadrant or axis of the points (**-** 2, 4), (3, **-** 1), (- 1, 0), (1, 2) and (**-** 3, **-** 5).

First, we need to plot the points (**-** 2, 4), (3, **-** 1), (- 1, 0), (1, 2) and (**-** 3, **-** 5) on the graph, to get



We need to determine the quadrant, in which the points (**-** 2, 4), (3, **-** 1), (- 1, 0), (1, 2) and (**-** 3, **-** 5) lie.

From the figure, we can conclude that the point (**-** 2, 4) lie in IInd quadrant.
From the figure, we can conclude that the point (3, **-** 1) lie in IVth quadrant.
From the figure, we can conclude that the point (**-**1, 0) lie on *x*-axis.

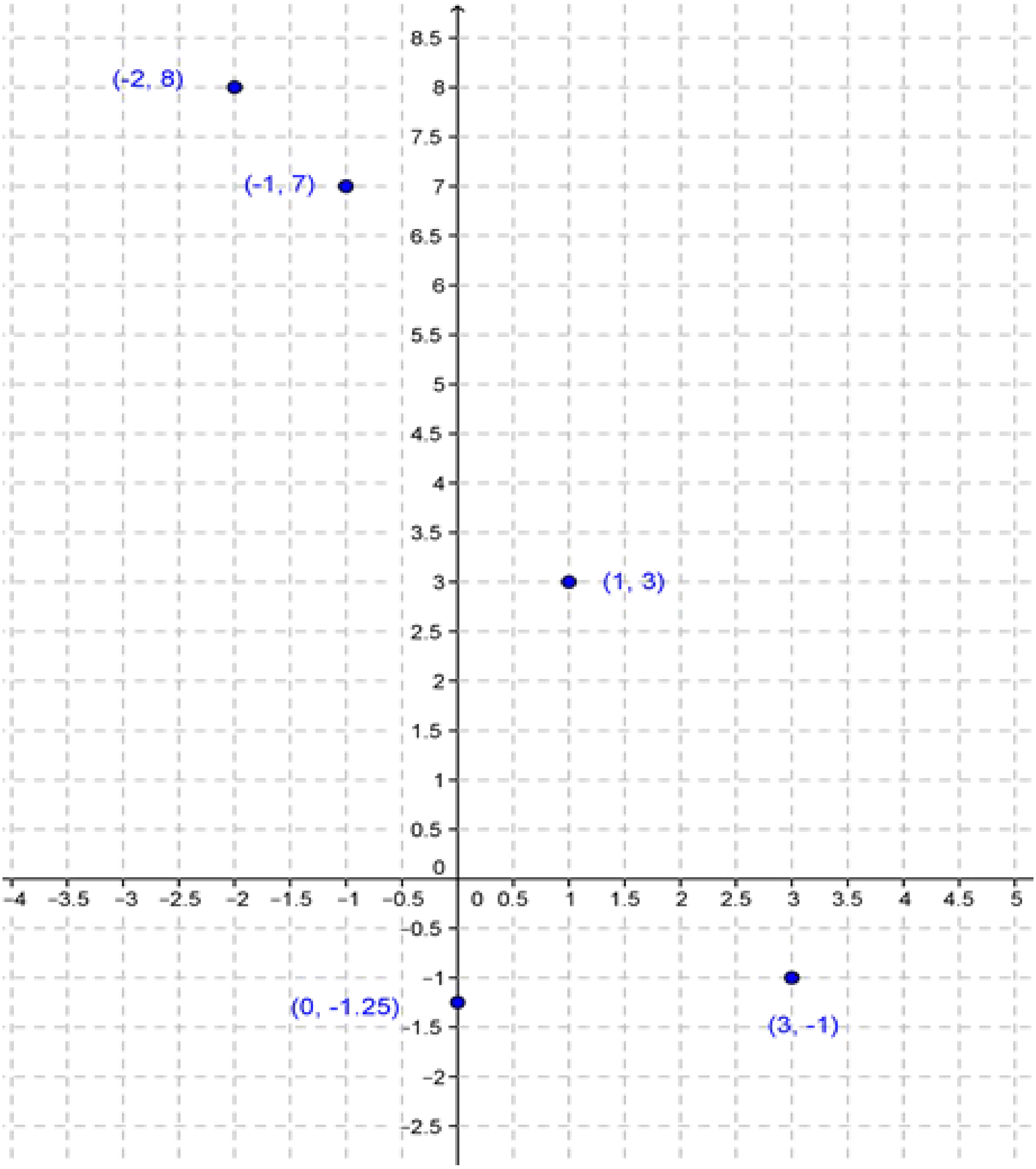
From the figure, we can conclude that the point (1, 2) lie in Ith quadrant.
From the figure, we can conclude that the point (**-** 3, **-** 5) lie in IIInd quadrant.

2. **Plot the points (*x*, *y*) given in the following table on the plane, choosing suitable units of distance on the axes.**

X	-2	-1	0	1	3
y	8	7	-1.25	3	-1

Ans. We need to plot the given below points on the graph by using a suitable scale.

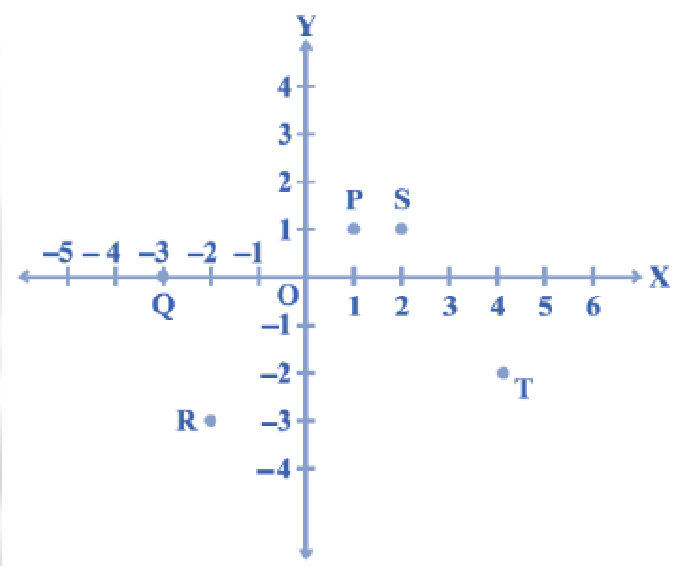
X	-2	-1	0	1	3
y	8	7	-1.25	3	-1



CHAP-3

Worksheet

1. Write the coordinates of each of the points P, Q, R, S, T and O from the figure given.



2. Plot the following points and check whether they are collinear or not:

(i) (1, 3), (– 1, – 1), (– 2, – 3)

(ii) (1, 1), (2, – 3), (– 1, – 2)

(iii) (0, 0), (2, 2), (5, 5)

3. Without plotting the points indicate the quadrant in which they will lie, if

(i) Ordinate is 5 and abscissa is – 3

(ii) Abscissa is – 5 and ordinate is – 3

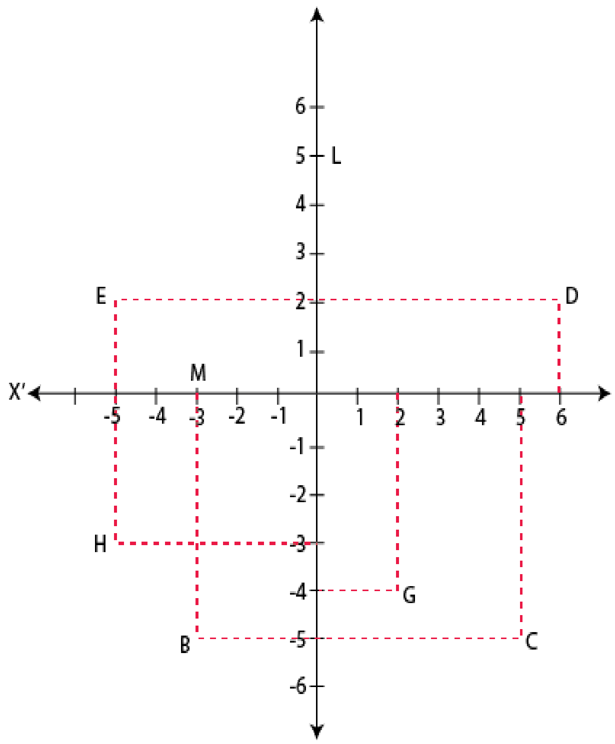
(iii) Abscissa is – 5 and ordinate is 3

(iv) Ordinate is 5 and abscissa is 3

4. See figure and write the following:

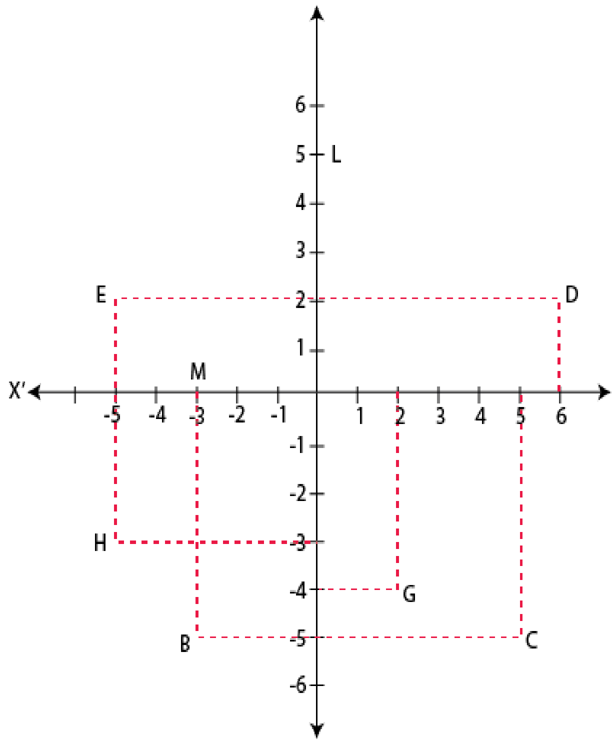
i. The coordinates of B.
ii. The coordinates of C.
iii. The point identified by the coordinates (–3, –5).
iv. The point identified by the coordinates (2, – 4).
v. The abscissa of the point D.
vi. The ordinate of the point H.
vii. The coordinates of the point L.

viii. The coordinates of the point M.



5. Plot the points (x, y) given in the following table on the plane, choosing suitable units of distance on the axes.

X	-2	-1	0	1	3
Y	8	7	-1.25	3	-1



6. Plot the points (x, y) given in the following table on the plane, choosing suitable units of distance on the axes.

X	-2	-1	0	1	3
Y	8	7	-1.25	3	-1