NCERT Solutions for 9 Maths

Chapter 1 – Number System

Exercise 1.4

1. Classify the Following Numbers as Rational or Irrational:

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

Ans: The given number is $2-\sqrt{5}$.

Here, $\sqrt{5}=2.236.....$ and it is a non-repeating and non-terminating irrational number.

Therefore, substituting the value of $\sqrt{5}$ gives

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

$=-0.236.....$, which is an irrational number.

So, $2-\sqrt{5}$ is an irrational number.

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

Ans: The given number is $\left(3+\sqrt{23}\right)-\left(\sqrt{23}\right)$.

The number can be written as

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

$= \frac{3}{1}$, which is in the $\frac{p}{q}$ form and so, it is a rational number.

Hence, the number $\left(3+\sqrt{23}\right)-\sqrt{23}$ is a rational number.

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

Ans: The given number is $\frac{2\sqrt{7}}{7\sqrt{7}}$.

The number can be written as

$\frac{2\sqrt{7}}{7\sqrt{7}} = \frac{2}{7}$, which is in the $\frac{p}{q}$ form and so, it is a rational number.

Hence, the number $\frac{2\sqrt{7}}{7\sqrt{7}}$ is a rational number.

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

Ans: The given number is $\frac{1}{\sqrt{2}}$.

It is known that, $\sqrt{2} = 1.414.....$ and it is a non-repeating and non-terminating irrational number.

Hence, the number $\frac{1}{\sqrt{2}}$ is an irrational number.

(v) 2π

Ans: The given number is 2π.

It is known that, $\pi = 3.1415$ and it is an irrational number.

Now remember that, Rational $\times$ Irrational = Irrational.

Hence, 2π is also an irrational number.

2. Simplify Each of the of the Following Expressions:

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

Ans: The given number is $\left(3+\sqrt{3}\right)\left(2+\sqrt{2}\right)$.

By calculating the multiplication, it can be written as

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

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

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

Ans: The given number is $\left(3+\sqrt{3}\right)\left(3-\sqrt{3}\right)$.

By applying the formula $(a+b)(a-b) = a^2 - b^2$, the number can be written as

$\left(3+\sqrt{3}\right)\left(3-\sqrt{3}\right) = 3^2 - \left(\sqrt{3}\right)^2 = 9 - 3 = 6$.

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

Ans: The given number is $\left(\sqrt{5}+\sqrt{2}\right)^2$.

Applying the formula $(a+b)^2 = a^{2+}2ab+b^2$, the number can be written as

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

$$= 5 + 2\sqrt{10} + 2$$

$$= 7 + 2\sqrt{10}.$$

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

Ans: The given number is $\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right)$.

Applying the formula $(a+b)(a-b) = a^2 - b^2$, the number can be expressed as

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

$$= 5 - 2$$
$$= 3.$$

3. Recall that, 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: It is known that $\pi = \frac{22}{7}$, which is a rational number. But, note that this value of π is an approximation.

On dividing 22 by 7, the quotient 3.14...is a non-recurring and non-terminating number. Therefore, it is an irrational number.

In order of increasing accuracy, approximate fractions are,

$\frac{22}{7}, \frac{333}{106}, \frac{355}{113}, \frac{52163}{16604}, \frac{103993}{33102}$, and $\frac{245850922}{78256779}$.

Each of the above quotients has the value 3.14..., which is a non-recurring and non-terminating number.

Thus, π is irrational.

So, either circumference (c) or diameter (d) or both should be irrational numbers.

Hence, it is concluded that there is no contradiction regarding the value of π and it is made out that the value of π is irrational.

4. Represent $\sqrt{9.3}$ on the number line.

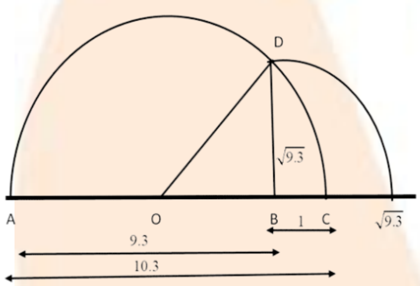
Ans: Follow the procedure given below to represent the number $\sqrt{9.3}$.

- First, mark the distance 9.3units from a fixed-point A on the number line to get a point B. Then AB=9.3 units.
- Secondly, from the point B mark a distance of 1 unit and denote the ending point as C.
- Thirdly, locate the midpoint of AC and denote as O.
- Fourthly, draw a semi-circle to the centre O with the radius $OC = 5.15$ units. Then

$$
\begin{aligned}
&AC = AB + BC \\
&= 9.3 + 1 \\
&= 10.3
\end{aligned}
$$

So, $OC = \frac{AC}{2} = \frac{10.3}{2} = 5.15$.

- Finally, draw a perpendicular line at B and draw an arc to the centre B and then let it meet at the semicircle AC at D as given in the diagram below.



5. Rationalize the denominators of the following:

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

Ans: The given number is $\frac{1}{\sqrt{7}}$.

Multiplying and dividing by $\sqrt{7}$ to the number gives

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

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

Ans: The given number is $\frac{1}{\sqrt{7}-\sqrt{6}}$.

Multiplying and dividing by $\sqrt{7}+\sqrt{6}$ to the number gives

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

Now, applying the formula $\left(a-b\right)\left(a+b\right)=a^2-b^2$ to the denominator gives

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

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

Ans: The given number is $\frac{1}{\sqrt{5}+\sqrt{2}}$.

Multiplying and dividing by $\sqrt{5}-\sqrt{2}$ to the number gives

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

Now, applying the formula $\left(a+b\right)\left(a-b\right)=a^2-b^2$ to the denominator gives

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

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

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

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

Ans: The given number is $\frac{1}{\sqrt{7}-2}$.

Multiplying and dividing by $\sqrt{7}+2$ to the number gives

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

Now applying the formula

$(a+b)(a-b)=a^2-b^2$ to the denominator gives

$$\frac{1}{\sqrt{7}-2}=\frac{\sqrt{7}+2}{\left(\sqrt{7}\right)^2-(2)^2}=\frac{\sqrt{7}+2}{7-4}=\frac{\sqrt{7}+2}{3}.$$