NUMBER SYSTEMS

EXERCISE 1.1

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

SOLUTION. Yes, zero is a rational number. It can be written as $\frac{0}{1} = \frac{0}{2} = \frac{0}{3}$, *etc.*, where denominator $q \neq 0$, it can be negative also. **Ans.**

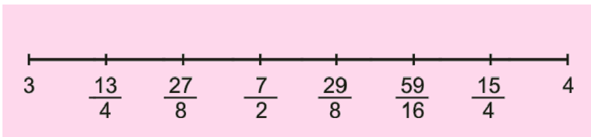
QUESTION 2. *Find six rational numbers between 3 and 4.*

SOLUTION.

S.No.	Numbers	Mid value
1	3 and 4	$\frac{1}{2}(3+4) = \frac{7}{2}$
2	3 and $\frac{7}{2}$	$\frac{1}{2}\left(3+\frac{7}{2}\right) = \frac{13}{4}$
3	$\frac{7}{2}$ and $\frac{13}{4}$	$\frac{1}{2}\left(\frac{7}{2}+\frac{13}{4}\right) = \frac{27}{8}$
4	4 and $\frac{7}{2}$	$\frac{1}{2}\left(4+\frac{7}{2}\right) = \frac{15}{4}$
5	$\frac{7}{2}$ and $\frac{15}{4}$	$\frac{1}{2}\left(\frac{7}{2}+\frac{15}{4}\right) = \frac{29}{8}$
6	$\frac{15}{4}$ and $\frac{29}{8}$	$\frac{1}{2}\left(\frac{15}{4}+\frac{29}{8}\right) = \frac{59}{16}$

Hence 6 rational numbers between 3 and 4 are

$$\mathbf{\frac{7}{2}, \frac{13}{4}, \frac{27}{8}, \frac{15}{4}, \frac{29}{8}, \frac{59}{16}}$$ **Ans.**



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

SOLUTION. Since we want to find out 5 numbers between $\frac{3}{5}$ and $\frac{4}{5}$, so we multiply the numerator and denominator of $\frac{3}{5}$ and $\frac{4}{5}$ by 5 + 1, *i.e.*, 6.

$$\frac{3}{5} = \frac{3 \times 6}{5 \times 6} = \frac{18}{30}$$

$$\frac{4}{5} = \frac{4 \times 6}{5 \times 6} = \frac{24}{30}$$

Hence, five rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$ **are $\frac{19}{30}, \frac{20}{30}, \frac{21}{30}, \frac{22}{30}$ and $\frac{23}{30}$.** **Ans.**

QUESTION 4. *Are the following statements true or false? Give reasons for your answer.*

(i) Every natural number is a whole number.

(ii) Every integer is a whole number.

(iii) Every rational number is a whole number.

SOLUTION. (*i*) **True,** since natural number starts from 1 to ∞ and whole number starts from 0 to ∞.

(*ii*) **False,** since negative integers are not whole numbers.

(*iii*) **False,** since rational number such that $\frac{1}{2}$ is not whole number. **Ans.**

EXERCISE 1.2

QUESTION 1. *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.

SOLUTION. (*i*) We know that real number is either rational or irrational. So we can say that every irrational number is a real number.

Hence, the given statement is **true.**

(*ii*) We know that real numbers can be represented on the number line. Thus, every point on the number line is of the form $\sqrt{m}$, where m is a natural number.

Hence, the given statement is **true.**

(*iii*) We know that, rational numbers and irrational numbers taken together are known as real numbers.

Hence, the given statement is **false.** **Ans.**

QUESTION 2. *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.*

SOLUTION. "The square roots of all positive integers are irrational.", is not correct.

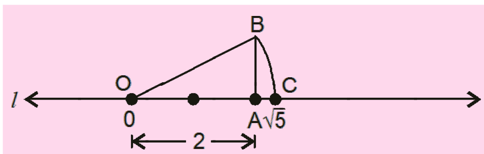
Since, square root of 9 *i.e.*, $\sqrt{9} = 3$, which is a rational number.

Hence, **the given statement is not correct.** **Ans.**

QUESTION 3. *Show how $\sqrt{5}$ can be represented on the number line.*

SOLUTION. We shall now show how to represent $\sqrt{5}$ on the number line.

Draw a number line l and mark a point O, representing zero (0), on it. Let point A represents 2 as shown in the figure. Now, construct a right-angled ΔOAB, right-angled at A such that $OA = 2$ units and $AB = 1$ unit (see figure).



By Pythagoras theorem, we have

$$OB = \sqrt{OA^2 + AB^2} = \sqrt{4+1} = \sqrt{5}$$

Draw an arc with centre O and radius OB to cut the number line at C. Clearly, $OC = OB = \sqrt{5}$.

Thus, the point C **represents the irrational number** $\sqrt{5}$. **Ans.**

QUESTION 4. *Classroom activity (Constructing the 'square root spiral') : Take a large sheet of paper and construct the 'square root spiral' in the following fashion. Start with a point O and draw a line segment OP_1 of unit length. Draw a line segment P_1P_2 perpendicular to OP_1 of unit length (see figure). Now draw a line segment P_2P_3 perpendicular to OP_2. Then draw a line segment P_3P_4 perpendicular to OP_3. Continuing in this manner, you can get the line segment $P_{n-1}P_n$ by drawing a line segment of unit length perpendicular to OP_{n-1}. In this manner, you will have created the point P_2, P_3, ... P_n, ... and join them to create a beautiful spiral depicting $\sqrt{2}, \sqrt{3}, \sqrt{4}$, ...*

SOLUTION. Classroom activity – **Do as directed.**

EXERCISE 1.3

QUESTION 1. *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*) $\frac{329}{400}$

SOLUTION. (*i*)

100) 360 (0.36
300
600
600
0

Hence, decimal form of $\frac{36}{100} = 0.36$

It has terminating decimal expansion. Ans.

(*ii*)

11) 100 (0.090909
99
100
99
100
99
100
99
1

Hence, decimal form of $\frac{1}{11} = 0.090909.... = 0.\overline{09}$

It has non terminating and repeating decimal expansion. Ans.

(*iii*) $4\frac{1}{8} = \frac{4 \times 8 + 1}{8} = \frac{32 + 1}{8} = \frac{33}{8}$

8) 33.000 (4.125
32
10
8
20
16
40
40
0

Hence, decimal form of $4\frac{1}{8} = 4.125$

It has terminating decimal expansion. Ans.

(*iv*)

13) 3.0000000 (0.23076923...
26
40
39
100
91
90
78
120
117
30
26
40
39
1

Hence, decimal form of $\frac{3}{13} = 0.23076923... = 0.\overline{230769}$

Also, **it has non terminating repeating decimal expansion. Ans.**

(*v*)

11) 2.00000 (0.181818...
11
90 A
88
20
11
90 B
88
20
11
90 C
88
2

$\therefore \frac{2}{11} = 0.1818......... = 0.\overline{18}$, **non-terminating and repeating decimal expansion.**

(*vi*)

$$
\begin{array}{r}
400 \,\big)\, \overline{329.000}\, \big(\, 0.8225 \\
\underline{3200} \\
900 \\
\underline{800} \\
1000 \\
\underline{800} \\
2000 \\
\underline{2000} \\
\underline{0}
\end{array}
$$

$\therefore \quad \frac{329}{400} = 0.8225,$ **terminating decimal.**

In the above examples, rational numbers are expressed into decimal form and the division process comes to an end without leaving any remainder. Such type of decimals are called terminating decimals. Since, the number of digits after decimal is finite, so these numbers are also called finite decimal forms. **Ans.**

QUESTION 2. ***You know that $\frac{1}{7} = 0.\overline{142857}$. 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?***

SOLUTION. Yes, we can 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.

All of the above will have repeating decimals which are permutations of 1, 4, 2, 8, 5, 7

For example:

$$
\begin{array}{r}
0.1428571... \\
7\,\big)\, \overline{1.0000000} \\
\underline{7} \\
30 \\
\underline{28} \\
20 \; \leftarrow \\
\underline{14} \\
60 \\
\underline{56} \\
40 \\
\underline{35} \\
50 \\
\underline{49} \\
10 \\
\underline{7} \\
\underline{3}
\end{array}
$$

In case of $\frac{2}{7}$

We divide 2 by 7. On putting a decimal point in the quotient, 2 becomes 20. In the above long division we also get 20 as remainder after two steps. See the respective quotient (Here it is 2). In the division of 2 by 7, the first quotient is 2 and then 8571.... .

Thus, $\quad \frac{2}{7} = 0.\overline{285714}$

To find $\frac{3}{7}$, we have to see the above long division when the remainder becomes 3 and see the respective quotient (here it is 4), then write the new quotient beginning from there.

Thus, $\frac{3}{7} = 0.\overline{428571}$

Similarly, $\frac{4}{7} = 0.\overline{571428}$

$\frac{5}{7} = 0.\overline{714285}$

$\frac{6}{7} = 0.\overline{857142}$ **Ans.**

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

(i) $0.\overline{6}$ *(ii)* $0.4\overline{7}$ *(iii)* $0.\overline{001}$

SOLUTION. ***(i)*** Let $x = 0.\overline{6}$

$\Rightarrow$ $x = 0.666....$ ...(1)

There is only one repeating digit (6) after decimal point so we multiply both side of (1) by 10.

$10x = 6.66...$ ...(2)

Subtracting (1) from (2), we get

$$10x - x = (6.66...) - (0.666....)$$

$$9x = 6$$

$\Rightarrow$ $x = \frac{6}{9}$

Hence, $0.\overline{6} = \frac{6}{9} = \mathbf{\frac{2}{3}}$. **Ans.**

(ii) Let $x = 0.4\overline{7}$ ...(1)

There is only one digit (4) without bar after decimal point in the given number, so we multiply both sides (1) by $10^1 = 10$.

$$10x = 4.\overline{7} \Rightarrow 10x = 4 + 0.\overline{7}$$

$\Rightarrow$ $10x = 4 + \frac{7}{9}$ (*By Rule*)

$\Rightarrow$ $10x = \frac{36+7}{9} \Rightarrow 10x = \frac{43}{9}$

$\Rightarrow$ $x = \frac{43}{90} \Rightarrow 0.4\overline{7} = \mathbf{\frac{43}{90}}$ $(\because x = 4.\overline{7})$ **Ans.**

(iii) Let $x = 0.\overline{001}$

$\Rightarrow$ $x = 0.001001001....$ ...(1)

There are three repeating digits (001) after decimal point so we multiply both sides of (1) by 10^3 *i.e.* 1000.

$1000x = 001.001001....$ ...(2)

Subtracting (1) from (2), we get

$$1000\,x - x = (001.001001...) - (0.001001001....)$$

$\Rightarrow$ $999\,x = 001 = 1$

$\Rightarrow$ $x = \frac{1}{999}$

Hence, $0.\overline{001} = \mathbf{\frac{1}{999}}$. **Ans.**

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

SOLUTION. Let $x = 0.99999...$ ...(1)

Here is only one repeating digit (9) after decimal point so we mutliply both sides of (1) by 10^1.

$$10x = 9.9999... \quad ...(2)$$

Subtracting (1) from (2), we get

$$10x - x = (9.9999....) - (0.99999...)$$

$\Rightarrow$ $9x = 9$

$\Rightarrow$ $x = 1$

Hence, $0.99999... = 1$

Since 0.99999... goes on forever. So, there is no gap between 1 and 0.99999... **and hence they are equal.**

Ans.

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

SOLUTION. Here, we have

$$\begin{array}{r}
0.0588235294117647 \\
17\,\overline{)\,1.0000000000000000} \\
\underline{85} \\
150 \\
\underline{136} \\
140 \\
\underline{136} \\
40 \\
\underline{34} \\
60 \\
\underline{51} \\
90 \\
\underline{85} \\
50 \\
\underline{34} \\
160 \\
\underline{153} \\
70 \\
\underline{68} \\
20 \\
\underline{17} \\
30 \\
\underline{17} \\
130 \\
\underline{119} \\
110 \\
\underline{102} \\
80 \\
\underline{68} \\
120 \\
\underline{119} \\
1
\end{array}$$

Thus, $\frac{1}{17} = 0.\overline{0588235294117647}$

Hence, the maximum number of digits in the repeating block while computing $\frac{1}{17}$ are **16.** **Ans.**

QUESTION 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 ?*

SOLUTION. Let the various such rational numbers be $\frac{1}{2}, \frac{1}{4}, \frac{7}{8}, \frac{37}{25}, \frac{8}{125}, \frac{17}{20}, \frac{31}{16}$ *etc.*

In all these cases we have to multiply the denominator q by such number so that it becomes 10 or a power of 10.

$$\frac{1}{2} = \frac{1\times 5}{2\times 5} = \frac{5}{10} = 0.5 \qquad [\because 2\times 5 = 10]$$

$$\frac{1}{4} = \frac{1\times 25}{4\times 25} = \frac{25}{100} = 0.25 \qquad [\because 4\times 25 = 100]$$

$$\frac{7}{8} = \frac{7\times 125}{8\times 125} = \frac{875}{1000} = 0.875 \qquad [\because 8\times 125 = 1000]$$

$$\frac{37}{25} = \frac{37\times 4}{25\times 4} = \frac{148}{100} = 1.48 \qquad [\because 25\times 4 = 100]$$

$$\frac{8}{125} = \frac{8\times 8}{125\times 8} = \frac{64}{1000} = 0.064 \qquad [\because 125\times 8 = 1000]$$

$$\frac{17}{20} = \frac{17\times 5}{20\times 5} = \frac{85}{100} = 0.85 \qquad [\because 20\times 5 = 100]$$

$$\frac{31}{16} = \frac{31\times 625}{16\times 625} = \frac{19375}{10000} = 1.9375 \qquad [\because 16\times 625 = 10000]$$

Thus we have observed that those rational numbers whose denominators when multiplied by a suitable integer produce a power of 10 are expressible in the finite decimal form. But this can always be done only when the denominator of the given rational number has either 2 or 5 or both of them as the only prime factors. Thus, we obtain the following property.

If the denominator of a rational number in standard form has no prime factors other than 2 or 5, then and only then it can be represented as a terminating decimal. **Ans.**

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

SOLUTION. Three numbers whose decimal representations are non-terminating and non-repeating are $\sqrt{2}, \sqrt{3}$ and $\sqrt{5}$ or we can say

0.1001000100001....., 0.202002000200002.... and 0.003000300003.... **Ans.**

QUESTION 8. *Find 3 different irrational numbers between the rational numbers $\frac{5}{7}$ and $\frac{9}{11}$.*

SOLUTION. We know that, $\frac{5}{7} = 0.714$ .... and $\frac{9}{11} = 0.818$ ....

We have to find out three irrational numbers between 0.714 .... and 0.818.....

The three irrational numbers between $\frac{5}{7}$ and $\frac{9}{11}$ are:

0.720720072000720000 72..................

0.760760076000760000 76..................

0.790790079000790000 79................. **Ans.**

QUESTION 9. *Classify the following numbers as rational or irrational:*

(i) $\sqrt{23}$ *(ii)* $\sqrt{225}$ *(iii) 0.3796*

(iv) 7.478478... *(v) 1.101001000100001...*

SOLUTION. *(i)* $\sqrt{23}$ is an irrational number as 23 **is not a perfect square.** **Ans.**

(*ii*) $\sqrt{225} = \sqrt{3 \times 3 \times 5 \times 5} = 3 \times 5$

$= 15$, which is a rational number.

Hence, $\sqrt{225}$ **is a rational number.**

(*iii*) 0.3796 is a terminating decimal and so **it is a rational number.**

(*iv*) 7.478478... is non terminating but repeating, so, **it is a rational number.**

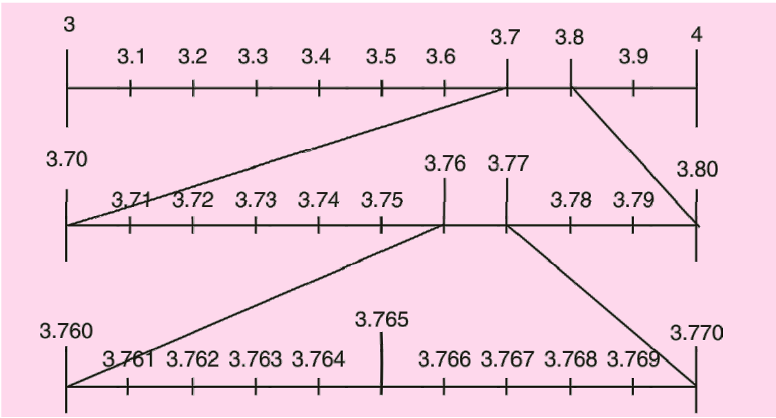
(*v*) 1.101001000100001... is non terminating and non repeating **so it is an irrational number.** **Ans.**

EXERCISE 1.4

QUESTION 1. *Visualise 3.765 on the number line, using succesive magnification.*

SOLUTION. This number lies between 3 and 4. The distance between 3 and 4 is divided into 10 equal parts. Then the first mark to the right of 3 will represent 3.1 and second 3.2 and so on. Now, 3.765 lies between 3.7 and 3.8. We divide the distance between 3.7 and 3.8 into 10 equal parts

3.76 will be on the right of 3.7 at the sixth mark, and 3.77 will be on the right of 3.7 at the 7th mark and 3.765 will lie between 3.76 and 3.77 and so on.

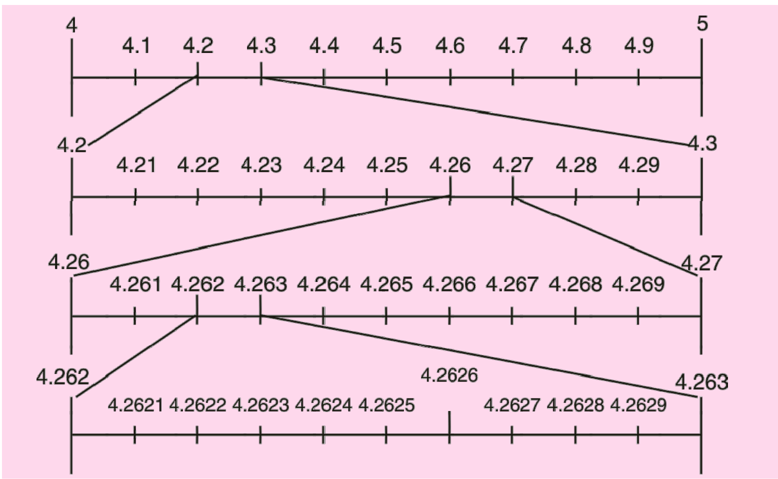


To mark 3.765, we have to use magnifying glass. **Ans.**

QUESTION 2. *Visualize* $4.\overline{26}$ *on the number line, upto 4 decimal places.*

SOLUTION. We have, $4.\overline{26} = 4.2626$

This number lies between 4 and 5. The distance between 4 and 5 is divided into 10 equal parts. Then the first mark to the right of 4 will represent 4.1 and second 4.2 and so on. Now, 4.2626 lies between 4.2 and 4.3. We divide the distance between 4.2 and 4.3 into 10 equal parts. 4.2626 lies between 4.26 and 4.27. Again we divide the distance between 4.26 and 4.27 into 10 equal parts. The number 4.2626 lies between 4.262 and 4.263. The distance between 4.262 and 4.263 is again divided into 10 equal parts. Sixth mark from right to the 4.262 is 4.2626.



Ans.

EXERCISE 1.5

QUESTION 1. *Classify the following numbers as rational or irrational :*

(i) $2-\sqrt{5}$ (ii) $(3+\sqrt{23})-\sqrt{23}$ (iii) $\dfrac{2\sqrt{7}}{7\sqrt{7}}$ (iv) $\dfrac{1}{\sqrt{2}}$ (v) 2π

SOLUTION. (i) $2-\sqrt{5}$, being a difference between a rational and an irrational is **an irrational number.**

(ii) $(3+\sqrt{23})-\sqrt{23}=3+\sqrt{23}-\sqrt{23}=3$ which is **rational number.**

(iii) $\dfrac{2\sqrt{7}}{7\sqrt{7}}=\dfrac{2}{7}$, which is **a rational number.**

(iv) $\dfrac{1}{\sqrt{2}}$, is the quotient of a rational and irrational and therefore it is **an irrational number.**

(v) 2π, is the product of rational and irrational and therefore it is **an irrational number.** **Ans.**

QUESTION 2. *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) $\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right)$

SOLUTION. (i) $\left(3+\sqrt{3}\right)\left(2+\sqrt{2}\right) = 3\times 2+3\sqrt{2}+2\sqrt{3}+\sqrt{2}\times\sqrt{3} = \mathbf{6+3\sqrt{2}+2\sqrt{3}+\sqrt{6}}$

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

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

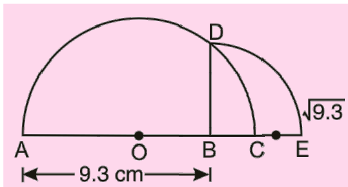
(iv) $\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right) = \left(\sqrt{5}\right)^2-\left(\sqrt{2}\right)^2=5-2=\mathbf{3}$ **Ans.**

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

SOLUTION. There is no contradiction. Remember that when we measure a length with a scale or any other device, we only get an *approximate rational value*. So, we may not realise that either c or d is irrational. Hence **π is an irrational.** **Ans.**

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

SOLUTION. 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 units and mark the new point as C. Find the mid-point of AC and mark that point as O. Draw a semi-circle with centre O and radius OC. Draw a line perpendicular to AC passing through B and intersecting the semi-circle at D. Then $BD=\sqrt{9.3}$. To represent $\sqrt{9.3}$ on the number line. Let us treat the line BC as the number line, with B as 0 and C as 1. Draw an arc with centre B and radius BD, which intersects the number line at E. Then, **E represents $\sqrt{9.3}$.**



QUESTION 5. *Rationalise the denominators of the following :*

(i) $\dfrac{1}{\sqrt{7}}$ (ii) $\dfrac{1}{\sqrt{7}-\sqrt{6}}$ (iii) $\dfrac{1}{\sqrt{5}+\sqrt{2}}$ (iv) $\dfrac{1}{\sqrt{7}-2}$

SOLUTION. (i)
$$\frac{1}{\sqrt{7}} = \frac{1\times\sqrt{7}}{\sqrt{7}\times\sqrt{7}}=\frac{\sqrt{7}}{7}$$

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

(iii)
$$\frac{1}{\sqrt{5}+\sqrt{2}} = \frac{1}{\sqrt{5}+\sqrt{2}} \times \frac{\sqrt{5}-\sqrt{2}}{\sqrt{5}-\sqrt{2}} = \frac{\sqrt{5}-\sqrt{2}}{(\sqrt{5})^2-(\sqrt{2})^2}$$
$$= \frac{\sqrt{5}-\sqrt{2}}{5-2} = \mathbf{\frac{\sqrt{5}-\sqrt{2}}{3}}$$

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

EXERCISE 1.6

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

SOLUTION. **(i)** We have, $64^{1/2} = (8 \times 8)^{1/2} = 8^{2 \times 1/2} = 8^1 = \mathbf{8}$ **Ans.**

(ii) We have, $32^{1/5} = (2 \times 2 \times 2 \times 2 \times 2)^{1/5} = (2^5)^{1/5}$

$= 2^{5 \times 1/5} = 2^1 = \mathbf{2}$ **Ans.**

(iii) We have, $125^{1/3} = (5 \times 5 \times 5)^{1/3} = (5^3)^{1/3} = 5^1 = \mathbf{5}$ **Ans.**

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

SOLUTION. **(i)** We have, $9^{3/2} = (3 \times 3)^{3/2} = (3^2)^{3/2} = 3^{2 \times 3/2} = 3^3$ $[\because (a^m)^n = a^{mn}]$

$= 3 \times 3 \times 3 = \mathbf{27}$ **Ans.**

(ii) We have, $32^{2/5} = (2 \times 2 \times 2 \times 2 \times 2)^{2/5}$

$= (2^5)^{2/5} = 2^{5 \times 2/5} = 2^2$ $[\because (a^m)^n = a^{mn}]$

$= 2 \times 2 = \mathbf{4}$ **Ans.**

(iii) We have, $16^{3/4} = (2 \times 2 \times 2 \times 2)^{3/4}$

$= (2^4)^{3/4} = 2^{4 \times 3/4} = 2^3$ $[\because (a^m)^n = a^{mn}]$

$= 2 \times 2 \times 2 = \mathbf{8}$ **Ans.**

(iv) We have, $125^{-1/3} = \frac{1}{125^{1/3}} = \frac{1}{(5 \times 5 \times 5)^{1/3}} = \frac{1}{5^{3 \times 1/3}} = \frac{1}{5^1} = \mathbf{\frac{1}{5}}$ **Ans.**

QUESTION 3. *Simplify : (i) $2^{2/3} . 2^{1/5}$ (ii) $\left(\frac{1}{3^2}\right)^7$ (iii) $\frac{11^{1/2}}{11^{1/4}}$ (iv) $7^{1/2} . 8^{1/2}$*

SOLUTION. **(i)** We have, $2^{2/3} . 2^{1/5} = 2^{2/3 + 1/5}$ $[\because a^m.a^n = a^{m+n}]$

$= 2^{\frac{10+3}{15}} = \mathbf{2^{\frac{13}{15}}}$ **Ans.**

(ii) We have, $\left(\frac{1}{3^2}\right)^7 = \frac{1^7}{3^{2 \times 7}} = \mathbf{\frac{1}{3^{14}}}$ $\left[\because \left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}\right]$ **Ans.**

(iii) We have, $\frac{11^{1/2}}{11^{1/4}} = 11^{\frac{1}{2}-\frac{1}{4}}$ $\left[\because \frac{a^m}{a^n} = a^{m-n}\right]$

$= 11^{\frac{2-1}{4}} = \mathbf{11^{1/4}}$ **Ans.**

(iv) We have, $7^{1/2} \times 8^{1/2} = (7 \times 8)^{1/2} = \mathbf{56^{1/2}}$ $[\because a^m.b^m = (ab)^m]$ **Ans.**