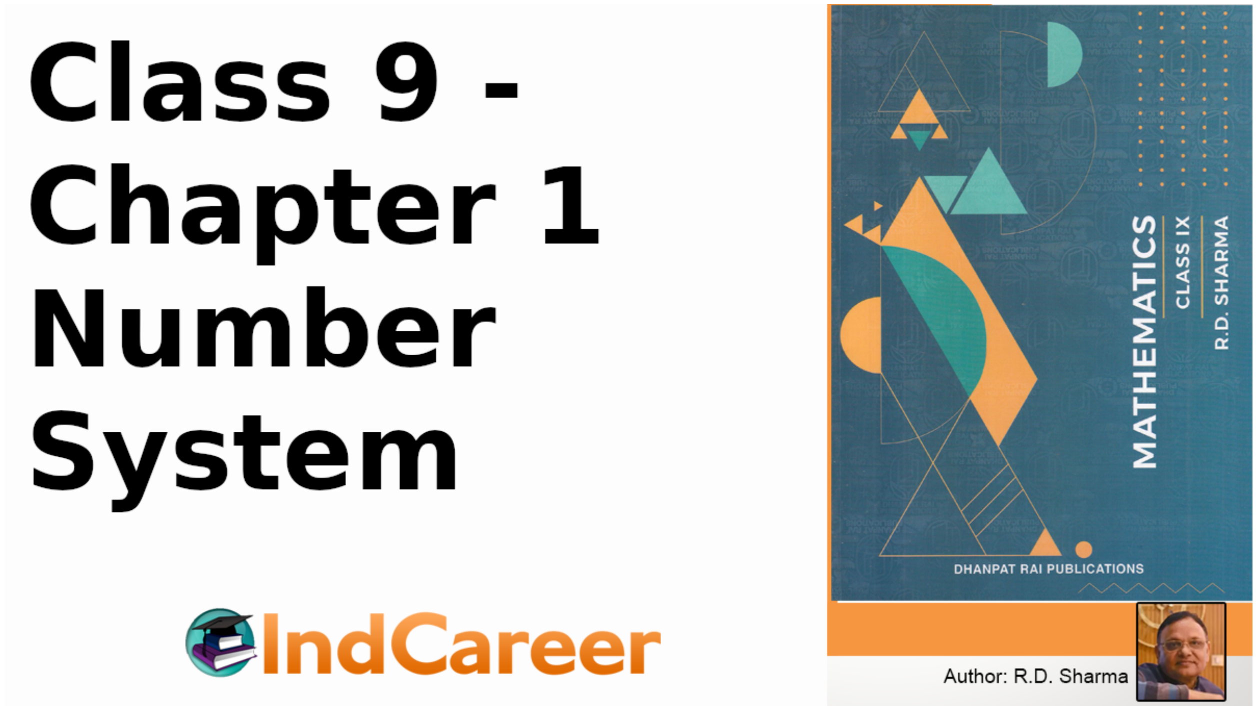

RD Sharma Solutions for Class 9 Maths Chapter 1–Number System

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Exercise 1.1

Question 1: Is zero a rational number? Can you write it in the form p/q, where p and q are integers and q ≠ 0?

Solution:

Yes, zero is a rational number.

It can be written in p/q form provided that q ≠ 0.

For Example: 0/1 or 0/3 or 0/4 etc.

Question 2: Find five rational numbers between 1 and 2.

Solution:

We know, one rational number between two numbers m and n = (m+n)/2

To find: 5 rational numbers between 1 and 2

Step 1: Rational number between 1 and 2

= (1+2)/2

= 3/2

Step 2: Rational number between 1 and 3/2

= (1+3/2)/2

= 5/4

Step 3: Rational number between 1 and 5/4

= (1+5/4)/2

= 9/8

Step 4: Rational number between 3/2 and 2

= 1/2 [(3/2) + 2)]

= 7/4

Step 5: Rational number between 7/4 and 2

= 1/2 [7/4 + 2]

= 15/8

Arrange all the results: 1 < 9/8 < 5/4 < 3/2 < 7/4 < 15/8 < 2

Therefore required integers are, 9/8, 5/4, 3/2, 7/4, 15/8

Question 3: Find six rational numbers between 3 and 4.

Solution:

Steps to find n rational numbers between any two numbers:

Step 1: Multiply and divide both the numbers by n+1.

In this example, we have to find 6 rational numbers between 3 and 4. Here n = 6

Multiply 3 and 4 by 7

3 x 7/7 = 21/7 and

4 x 7/7 = 28/7

Step 2: Choose 6 numbers between 21/7 and 28/7

3 = 21/7 < 22/7 < 23/7 < 24/7 < 25/7 < 26/7 < 27/7 < 28/7 = 4

Therefore, 6 rational numbers between 3 and 4 are

22/7, 23/7, 24/7, 25/7, 26/7, 27/7

Question 4: Find five rational numbers between 3/5 and 4/5.

Solution:

Steps to find n rational numbers between any two numbers:

Step 1: Multiply and divide both the numbers by n+1.

In this example, we have to find 5 rational numbers between 3/5 and 4/5. Here n = 5

Multiply 3/5 and 4/5 by 6

3/5 x 6/6 = 18/30 and

4/5 x 6/6 = 24/30

Step 2: Choose 5 numbers between 18/30 and 24/30

3/5 = 18/30 < 19/30 < 20/30 < 21/30 < 22/30 < 23/30 < 24/30 = 4/5

Therefore, 5 rational numbers between 3/5 and 4/5 are

19/30, 20/30, 21/30, 22/30, 23/30

Question 5: Are the following statements true or false? Give reason for your answer.

(i) Every whole number is a natural number.

(ii) Every integer is a rational number.

(iii) Every rational number is an integer.

(iv) Every natural number is a whole number,

(v) Every integer is a whole number.

(vi) Every rational number is a whole number.

Solution:

(i) False.

Reason: As 0 is not a natural number.

(ii) True.

(iii) False.

Reason: Numbers such as 1/2, 3/2, 5/3 are rational numbers but not integers.

(iv) True.

(v) False.

Reason: Negative numbers are not whole numbers.

(vi) False.

Reason: Proper fractions are not whole numbers

Exercise 1.2

Question 1: Express the following rational numbers as decimals.

(i) 42/100 (ii) 327/500 (iii) 15/4

Solution:

(i) By long division method

100) $\overline{42}$ (0.42

400

$\overline{200}$

200

$\overline{0}$

Therefore, $\frac{42}{100}$ = 0.42

(ii) By long division method

500) $\overline{327.000}$ (0.654

3000

$\overline{2700}$

2500

$\overline{2000}$

2000

$\overline{0}$

Therefore, $\frac{327}{500}$ = 0.654

(iii) By long division method

4) $\overline{15.00}$ (3.75

12

$\overline{30}$

28

$\overline{20}$

20

$\overline{0}$

Therefore, $\frac{15}{4}$ = 3.75

Question 2: Express the following rational numbers as decimals.

(i) 2/3 (ii) -4/9 (iii) -2/15 (iv) -22/13 (v) 437/999 (vi) 33/26

Solution:

(i) Divide 2/3 using long division:

$$
\begin{array}{r|l}
 & \;0.66666 \\
\hline
3 & 2.00000 \\
 & \underline{0} \\
 & 20 \\
 & \underline{18} \\
 & \;\;20 \\
 & \;\;\underline{18} \\
 & \;\;\;\;20 \\
 & \;\;\;\;\underline{18} \\
 & \;\;\;\;\;\;20 \\
 & \;\;\;\;\;\;\underline{18} \\
 & \;\;\;\;\;\;\;\;20 \\
 & \;\;\;\;\;\;\;\;\underline{18} \\
 & \;\;\;\;\;\;\;\;\;\;2
\end{array}
$$

$$\frac{2}{3} = 0.666\ldots = 0.\bar{6}$$

(ii) Divide using long division: -4/9

$9)\,\overline{4.000}\,(\,0.444$

3600

$\overline{4000}$

3600

$\overline{4000}$

3600

$\overline{400}$

$-\frac{4}{9} = -\,0.4444\ldots = -0.\bar{4}$

(iii) Divide using long division: -2/15

$$\begin{array}{r} 0.133 \\ 15\overline{)2.0000} \\ 15 \\ \hline 50 \\ 45 \\ \hline 50 \\ 45 \\ \hline 6 \end{array}$$

$-\frac{2}{15} = -0.133 = -0.1\bar{3}$

(iv) Divide using long division: -22/13

$$
\begin{array}{r l}
 & 1.69230769 \\
13) & \overline{22.000} \\
 & 13 \\
 & \overline{90} \\
 & 78 \\
 & \overline{120} \\
 & 117 \\
 & \overline{30} \\
 & 26 \\
 & \overline{40} \\
 & 39 \\
 & \overline{100} \\
 & 91 \\
 & \overline{90} \\
 & 78 \\
 & \overline{120} \\
 & 117 \\
 & \overline{3}
\end{array}
$$

$$\frac{-22}{13} = -1.6923076923... = -1.\overline{692307}$$

(v) Divide using long division: 437/999

$$999\overline{)437.0000}(0.43743$$

3996

$\overline{3740}$

2997

$\overline{7430}$

6993

$\overline{4370}$

3996

$\overline{3740}$

2997

$\overline{743}$

$\frac{437}{999} = 0.43743... = 0.\overline{437}$

(vi) Divide using long division: 33/26

$$
\begin{array}{r}
1.2692307692 \\
26\overline{)33.000000000} \\
26 \\
\hline
70 \\
52 \\
\hline
180 \\
156 \\
\hline
240 \\
234 \\
\hline
60 \\
52 \\
\hline
80 \\
78 \\
\hline
200 \\
182 \\
\hline
180 \\
156 \\
\hline
24
\end{array}
$$

$$\frac{33}{26} = 1.269230769... = 1.2\overline{692307}$$

Question 3: Look at several examples of rational numbers in the form p/q (q ≠ 0), where p and q are integers with no common factors other than 1 and having terminating decimal representations. Can you guess what property q must satisfy?

Solution:

The decimal representation will be terminating, if the denominators have factors 2 or 5 or both. Therefore, p/q is a terminating decimal, when prime factorization of q must have only powers of 2 or 5 or both.

Exercise 1.3

Question 1: Express each of the following decimals in the form p/q:

(i) 0.39

(ii) 0.750

(iii) 2.15

(iv) 7.010

(v) 9.90

(vi) 1.0001

Solution:

(i)

0.39 = 39/100

(ii)

0.750 = 750/1000 = 3/4

(iii)

2.15 = 215/100 = 43/20

(iv)

7.010 = 7010/1000 = 701/100

(v)

9.90 = 990/100 = 99/10

(vi)

1.0001 = 10001/10000

Question 2: Express each of the following decimals in the form p/q:

(i) $0.\overline{4}$ (ii) $0.\overline{37}$

(iii) $0.\overline{54}$ (iv) $0.\overline{621}$

(v) $125.\overline{3}$ (vi) $4.\overline{7}$

(vii) $0.4\overline{7}$

Solution:

(i) Let x = $0.\overline{4}$

or x = $0.\overline{4}$ = 0.444 …. (1)

Multiplying both sides by 10

10x = 4.444 …..(2)

Subtract (1) by (2), we get

10x – x = 4.444… – 0.444…

9x = 4

x = 4/9

=> $0.\overline{4}$ = 4.9

(ii) Let x = 0.3737.. …. (1)

Multiplying both sides by 100

100x = 37.37… …..(2)

Subtract (1) from (2), we get

100x – x = 37.37… – 0.3737…

100x – x = 37

99x = 37

x = 37/99

(iii) Let x = 0.5454… (1)

Multiplying both sides by 100

100x = 54.5454…. (2)

Subtract (1) from (2), we get

100x – x = 54.5454…. – 0.5454….

99x = 54

x = 54/99

(iv) Let x = 0.621621… (1)

Multiplying both sides by 1000

1000x = 621.621621…. (2)

Subtract (1) from (2), we get

1000x – x = 621.621621…. – 0.621621….

999x = 621

x = 621/999

or x = 23/37

(v) Let x = 125.3333…. (1)

Multiplying both sides by 10

10x = 1253.3333…. (2)

Subtract (1) from (2), we get

10x – x = 1253.3333…. – 125.3333….

9x = 1128

or x = 1128/9

or x = 376/3

(vi) Let x = 4.7777…. (1)

Multiplying both sides by 10

10x = 47.7777…. (2)

Subtract (1) from (2), we get

10x – x = 47.7777…. – 4.7777….

9x = 43

x = 43/9

(vii) Let x = 0.47777….

Multiplying both sides by 10

10x = 4.7777…. …(1)

Multiplying both sides by 100

100x = 47.7777…. (2)

Subtract (1) from (2), we get

100x – 10x = 47.7777…. – 4.7777…

90x = 43

x = 43/90

Exercise 1.4

Question 1: Define an irrational number.

Solution:

A number which cannot be expressed in the form of p/q, where p and q are integers and q ≠ 0. It is non-terminating or non-repeating decimal.

Question 2: Explain, how irrational numbers differ from rational numbers?

Solution:

An irrational number is a real number which can be written as a decimal but not as a fraction i.e. it cannot be expressed as a ratio of integers.

It cannot be expressed as terminating or repeating decimal.

For example, √2 is an irrational number

A rational number is a real number which can be written as a fraction and as a decimal i.e. it can be expressed as a ratio of integers.

It can be expressed as terminating or repeating decimal.

For examples: 0.10 and 5/3 are rational numbers

Question 3: Examine, whether the following numbers are rational or irrational:

(i) $\sqrt{7}$ (ii) $\sqrt{4}$ (iii) $2 + \sqrt{3}$ (iv) $\sqrt{3} + \sqrt{2}$

(v) $\sqrt{3} + \sqrt{5}$ (vi) $(\sqrt{2} - 2)^2$ (vii) $(2 - \sqrt{2})(2 + \sqrt{2})$

(viii) $(\sqrt{3} + \sqrt{2})^2$ (ix) $\sqrt{5} - 2$ (x) $\sqrt{23}$

(xi) $\sqrt{225}$ (xii) 0.3796 (xiii) 7.478478……

(xiv) 1.101001000100001……

Solution:

(i) √7

Not a perfect square root, so it is an irrational number.

(ii) √4

A perfect square root of 2.

We can express 2 in the form of 2/1, so it is a rational number.

(iii) 2 + √3

Here, 2 is a rational number but √3 is an irrational number

Therefore, the sum of a rational and irrational number is an irrational number.

(iv) √3 + √2

√3 is not a perfect square thus an irrational number.

√2 is not a perfect square, thus an irrational number.

Therefore, sum of $\sqrt{2}$ and $\sqrt{3}$ gives an irrational number.

(v) $\sqrt{3} + \sqrt{5}$

$\sqrt{3}$ is not a perfect square and hence, it is an irrational number

Similarly, $\sqrt{5}$ is not a perfect square and also an irrational number.

Since, sum of two irrational number, is an irrational number, therefore $\sqrt{3} + \sqrt{5}$ is an irrational number.

(vi) $(\sqrt{2} - 2)^2$

$(\sqrt{2} - 2)^2 = 2 + 4 - 4\sqrt{2}$

$= 6 - 4\sqrt{2}$

Here, 6 is a rational number but $4\sqrt{2}$ is an irrational number.

Since, the sum of a rational and an irrational number is an irrational number, therefore, $(\sqrt{2} - 2)2$ is an irrational number.

(vii) $(2 - \sqrt{2})(2 + \sqrt{2})$

We can write the given expression as;

$(2 - \sqrt{2})(2 + \sqrt{2}) = ((2)^2 - (\sqrt{2})^2)$[Since, $(a + b)(a - b) = a^2 - b^2$]

$= 4 - 2 = 2$ or $2/1$

Since, 2 is a rational number, therefore, $(2 - \sqrt{2})(2 + \sqrt{2})$ is a rational number.

(viii) $(\sqrt{3} + \sqrt{2})^2$

We can write the given expression as;

$(\sqrt{3} + \sqrt{2})^2 = (\sqrt{3})^2 + (\sqrt{2})^2 + 2\sqrt{3} \times \sqrt{2}$

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

$= 5 + 2\sqrt{6}$[using identity, $(a+b)^2 = a^2 + 2ab + b^2$]

Since, the sum of a rational number and an irrational number is an irrational number, therefore, $(\sqrt{3} + \sqrt{2})^2$ is an irrational number.

(ix) √5 – 2

√5 is an irrational number whereas 2 is a rational number.

The difference of an irrational number and a rational number is an irrational number.

Therefore, √5 – 2 is an irrational number.

(x) √23

Since, √23 = 4.795831352331…

As decimal expansion of this number is non-terminating and non-recurring therefore, it is an irrational number.

(xi) √225

√225 = 15 or 15/1

√225 is rational number as it can be represented in the form of p/q and q not equal to zero.

(xii) 0.3796

As the decimal expansion of the given number is terminating, therefore, it is a rational number.

(xiii) 7.478478……

As the decimal expansion of this number is non-terminating recurring decimal, therefore, it is a rational number.

(xiv) 1.101001000100001……

As the decimal expansion of given number is non-terminating and non-recurring, therefore, it is an irrational number

Question 4: Identify the following as rational or irrational numbers. Give the decimal representation of rational numbers:

(i) √4 (ii) 3 √18 (iii) √1.44

(iv) $\sqrt{\frac{9}{27}}$ (v) – √64 (vi) √100

Solution:

(i) √4

√4 = 2, which can be written in the form of a/b. Therefore, it is a rational number.

Its decimal representation is 2.0.

(ii) 3√18

3√18 = 9√2

Since, the product of a rational and an irrational number is an irrational number.

Therefore, 3√18 is an irrational.

Or 3 × √18 is an irrational number.

(iii) √1.44

√1.44 = 1.2

Since, every terminating decimal is a rational number, Therefore, √1.44 is a rational number.

And, its decimal representation is 1.2.

(iv) √9/27

√9/27 = 1/√3

Since, we know, quotient of a rational and an irrational number is irrational numbers, therefore, √9/27 is an irrational number.

(v) – √64

– √64 = – 8 or – 8/1

Therefore, – √64 is a rational number.

Its decimal representation is –8.0.

(vi) √100

√100 = 10

Since, 10 can be expressed in the form of a/b, such as 10/1,

Therefore, √100 is a rational number.

And it's decimal representation is 10.0.

Question 5: In the following equation, find which variables x, y, z etc. represent rational or irrational numbers:

(i) $x^2 = 5$

(ii) $y^2 = 9$

(iii) $z^2 = 0.04$

(iv) $u^2 = 17/4$

(v) $v^2 = 3$

(vi) $w^2 = 27$

(vii) $t^2 = 0.4$

Solution:

(i) $x^2 = 5$

Taking square root both the sides,

$x = \sqrt{5}$

√5 is not a perfect square root, so it is an irrational number.

(ii) $y^2 = 9$

$y^2 = 9$

or $y = 3$

3 can be expressed in the form of a/b, such as 3/1, so it a rational number.

(iii) $z^2 = 0.04$

$z^2 = 0.04$

Taking square root both the sides, we get

$z = 0.2$

0.2 can be expressed in the form of a/b such as 2/10, so it is a rational number.

(iv) $u^2 = 17/4$

Taking square root both the sides, we get

$u = \sqrt{17}/2$

Since, quotient of an irrational and a rational number is irrational, therefore, u is an Irrational number.

(v) $v^2 = 3$

Taking square root both the sides, we get

$v = \sqrt{3}$

Since, $\sqrt{3}$ is not a perfect square root, so v is irrational number.

(vi) $w^2 = 27$

Taking square root both the sides, we get

$w = 3\sqrt{3}$

Since, the product of a rational and irrational is an irrational number. Therefore, w is an irrational number.

(vii) $t^2 = 0.4$

Taking square root both the sides, we get

$t = \sqrt{(4/10)}$

$t = 2/\sqrt{10}$

Since, quotient of a rational and an irrational number is irrational number. Therefore, t is an irrational number.

Exercise 1.5

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Question 1: Complete the following sentences:

(i) Every point on the number line corresponds to a …… number which many be either …… or …….

(ii) The decimal form of an irrational number is neither ….. nor ……

(iii) The decimal representation of a rational number is either ….. or …..

(iv) Every real number is either … number or … number.

Solution:

(i) Every point on the number line corresponds to a **real** number which many be either **rational** or **irrational**.

(ii) The decimal form of an irrational number is neither **terminating** nor **repeating**.

(iii) The decimal representation of a rational number is either **terminating** or **non-terminating recurring**.

(iv) Every real number is either **rational** number or **an irrational** number.

Question 2: Represent √6, √7, √8 on the number line.

Solution:

Find the equivalent values of √6, √7, √8

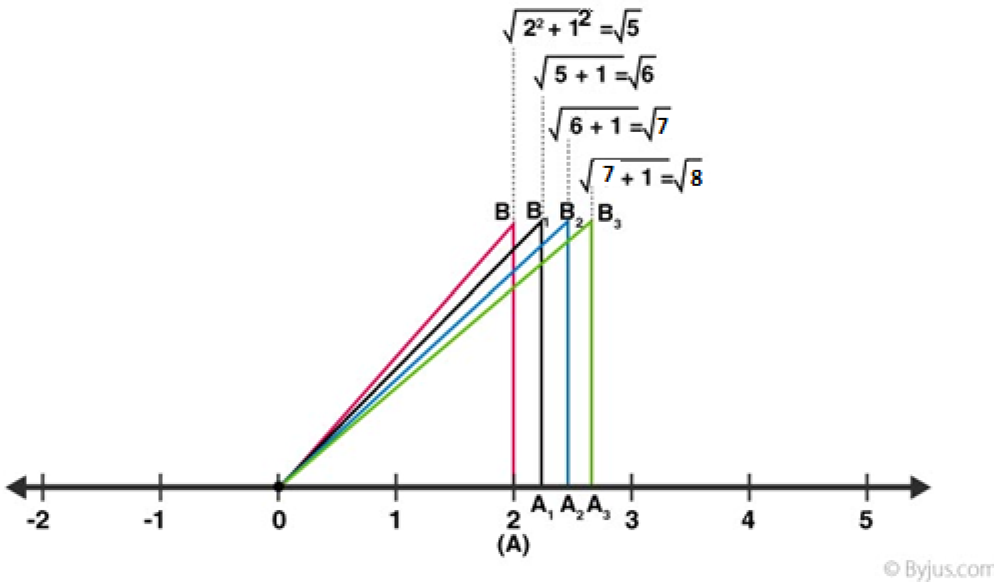
$\sqrt{6} = 2.449$

$\sqrt{7} = 2.645$

$\sqrt{8} = 2.828$

We can see that, all the given numbers lie between 2 and 3.

Draw on number line:



Question 3: Represent √3.5, √9.4, √10.5 and on the real number line.

Solution:

Represent √3.5 on number line

Step 1: Draw a line segment AB = 3.5 units

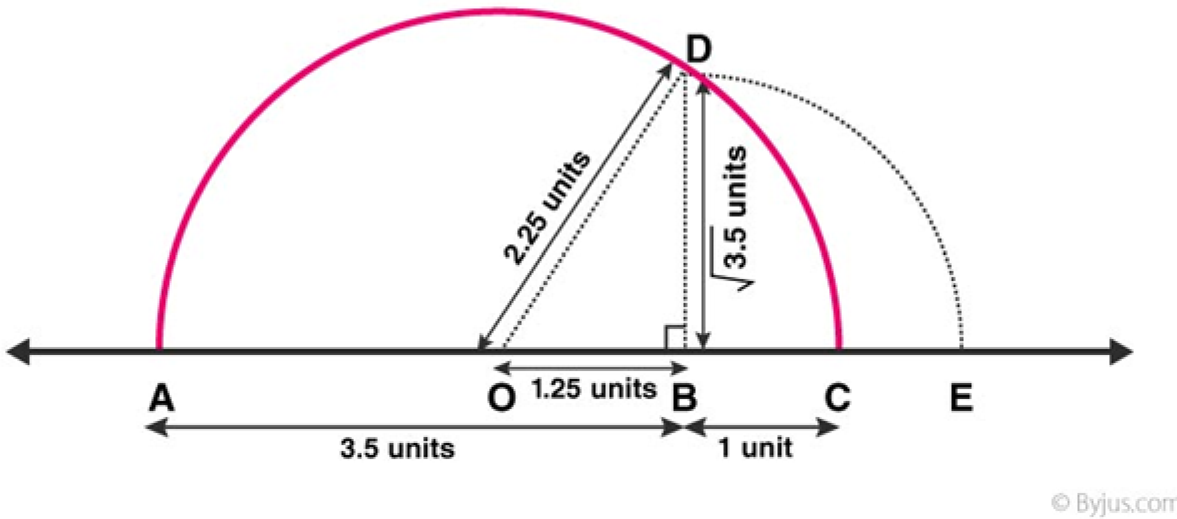
Step 2: Produce B till point C, such that BC = 1 unit

Step 3: Find the mid-point of AC, say O.

Step 4: Taking O as the centre draw a semi circle, passing through A and C.

Step 5: Draw a line passing through B perpendicular to OB, and cut semicircle at D.

Step 6: Consider B as a centre and BD as radius draw an arc cutting OC produced at E.



Now, from right triangle OBD,

$BD^2 = OD^2 – OB^2$

$= OC^2 – (OC – BC)^2$

(As, OD = OC)

$BD^2 = 2OC \times BC – (BC)^2$

$= 2 \times 2.25 \times 1 – 1$

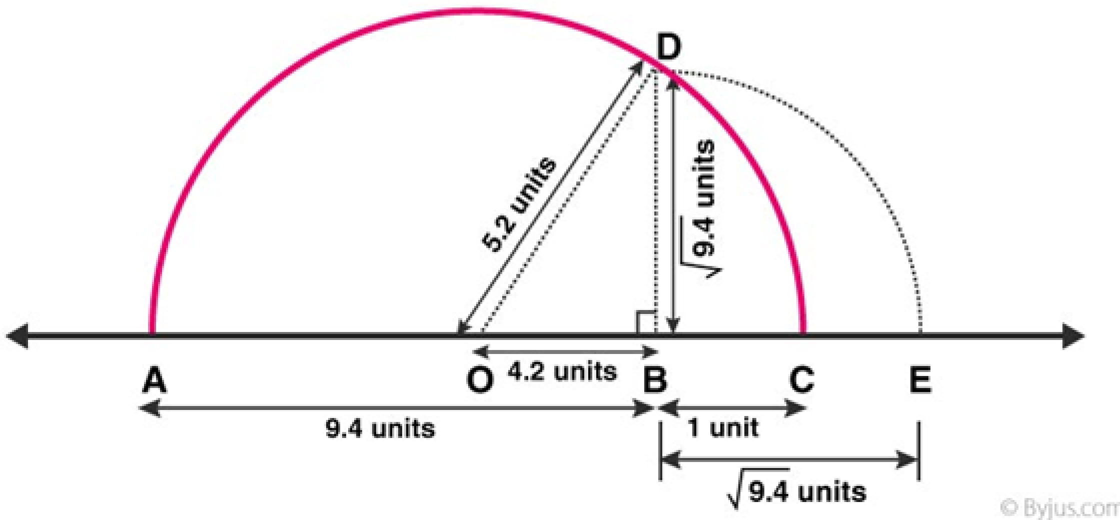
$= 3.5$

$\Rightarrow BD = \sqrt{3.5}$

Represent √9.4 on number line

Step 1: Draw a line segment AB = 9.4 units

Follow step 2 to Step 6 mentioned above.



$BD^2 = 2OC \times BC – (BC)^2$

$= 2 \times 5.2 \times 1 – 1$

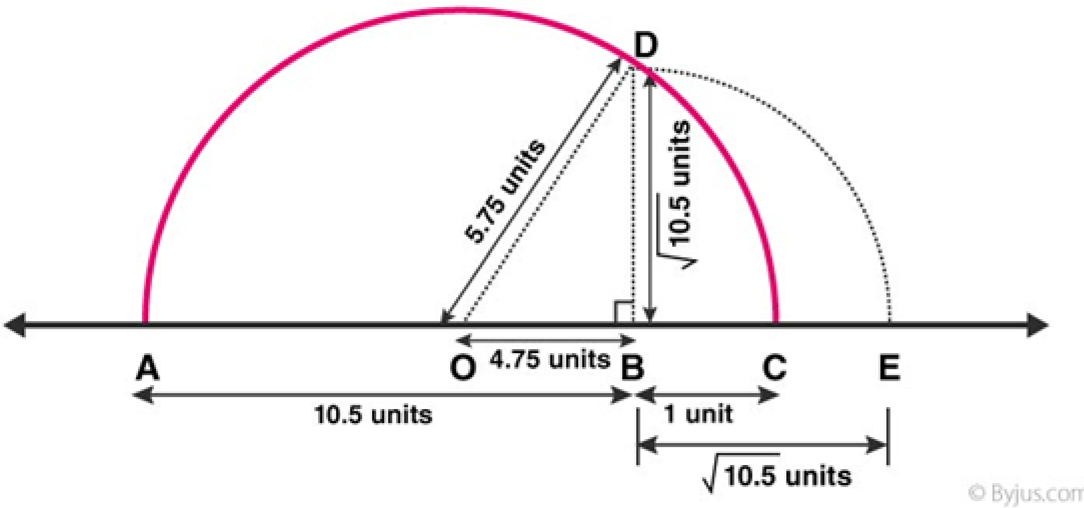
$= 9.4$

=> $BD = \sqrt{9.4}$

Represent √10.5 on number line

Step 1: Draw a line segment AB = 10.5 units

Follow step 2 to Step 6 mentioned above, we get



$BD^2 = 2OC \times BC - (BC)^2$

$= 2 \times 5.75 \times 1 - 1$

$= 10.5$

$\Rightarrow BD = \sqrt{10.5}$

Question 4: Find whether the following statements are true or false:

(i) Every real number is either rational or irrational.

(ii) π is an irrational number.

(iii) Irrational numbers cannot be represented by points on the number line.

Solution:

(i) True.

(ii) True.

(ii) False.

Exercise 1.6

Question 1: Visualise 2.665 on the number line, using successive magnification.

Solution:

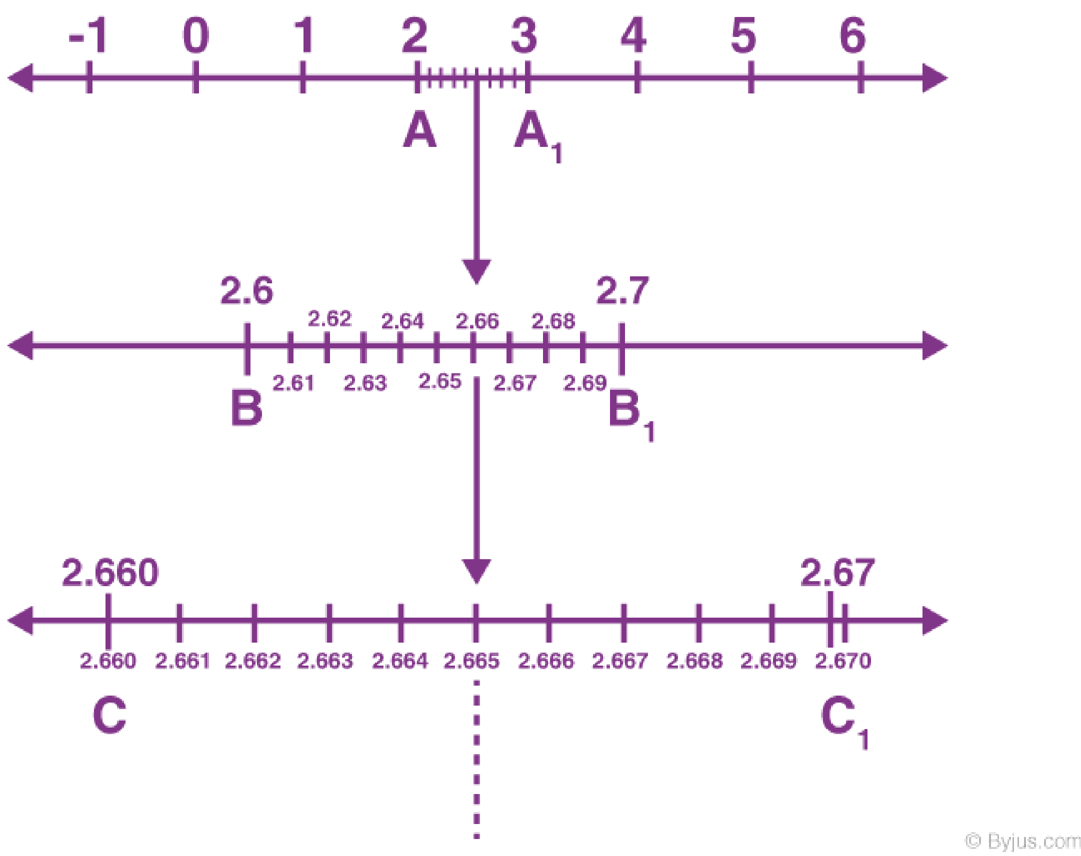
2.665 is lies between 2 and 3 on the number line.

Divide selected segment into 10 equal parts and mark each point of division as 2.1, 2.2, ….,2.9, 2.10

2.665 is lies between 2.6 and 2.7

Divide line segment between 2.6 and 2.7 in 10 equal parts such as 2.661, 2.662, and so on.

Here we can see that 5th point will represent 2.665.



Question 2: Visualise the representation of $5.3\overline{7}$ on the number line upto 5 decimal places, that is upto 5.37777.

Solution:

Clearly $5.3\overline{7}$ is located between 5 and 6.

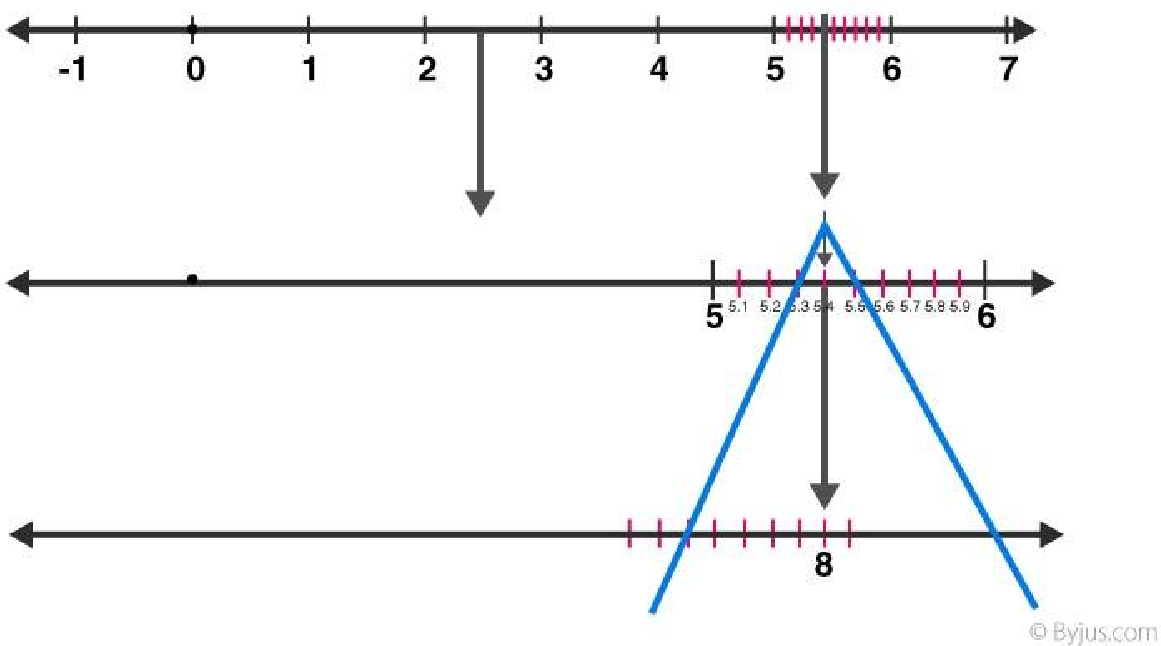
Again by successive magnification, and successively decrease $5.3\overline{7}$ located between 5.3 and 5.4.

For more clarity, divide 5.3 and 5.4 portion of the number line into 10 equal parts and we can see $5.3\overline{7}$ lies between 5.37 and 5.38.

To visualize $5.3\overline{7}$ more accurately, divide line segment between 5.37 and 5.38 in ten equal parts.

$5.3\overline{7}$ lies between 5.377 and 5.378.

Again divide above portion between 5.377 and 5.378 into 10 equal parts, which shows $5.3\overline{7}$ is located closer to 5.3778 than to 5.3777



Chapterwise RD Sharma Solutions for Class 9 Maths :

About RD Sharma

RD Sharma i*sn't the kind of author you'd bump into at lit fests. But his bestselling books have helped many* CBSE *students lose their dread of* maths. *Sunday Times profiles the tutor turned internet star*

He dreams of algorithms that would give most people nightmares. And, spends every waking hour thinking of ways to explain concepts like 'series solution of linear differential equations'. Meet Dr Ravi Dutt Sharma — mathematics teacher and author of 25 reference books — whose name evokes as much awe as the subject he teaches. And though students have used his thick tomes for the last 31 years to ace the dreaded maths exam, it's only recently that a spoof video turned the tutor into a YouTube star.

R D Sharma had a good laugh but said he shared little with his on-screen persona except for the love for maths. "I like to spend all my time thinking and writing about maths problems. I find it relaxing," he says. When he is not writing books explaining mathematical concepts for classes 6 to 12 and engineering students, Sharma is busy dispensing his duty as vice-principal and head of department of science and humanities at Delhi government's Guru Nanak Dev Institute of Technology.