RD SHARMA

Solutions

Class 9 Maths

Chapter 1

Ex *1.1*

Q1. Is 0 a rational number? Can you write it in the form $\frac{P}{Q}$, where P and Q are integers and Q ≠ 0?

Solution:

Yes, 0 is a rational number and it can be written in $P \div Q$ form provided that Q ≠ 0

0 is an integer and it can be written various forms, for example

$0 \div 2, 0 \div 100, 0 \div 95$ etc.

Q2. Find five rational numbers between 1 and 2

Solution:

Given that to find out 5 rational numbers between 1 and 2

Rational number lying between 1 and 2

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

= $\frac{3}{2}$

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

Rational number lying between 1 and $\frac{3}{2}$

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

= $\frac{5}{4}$

= $1 < \frac{5}{4} < \frac{3}{2}$

Rational number lying between 1 and $\frac{5}{4}$

= $\frac{1+\frac{5}{4}}{2}$ Rational number lying between $\frac{3}{2}$ and 2

= $\frac{9}{8}$

= $1 < \frac{9}{8} < \frac{5}{4}$

Rational number lying between $\frac{3}{2}$ and 2

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

= $\frac{7}{4}$

= $\frac{3}{2} < \frac{7}{4} < 2$

Rational number lying between $\frac{7}{4}$ and 2

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

= $\frac{15}{8}$

= $\frac{7}{4} < \frac{15}{8} < 2$

Therefore, $1 < \frac{9}{8} < \frac{5}{4} < \frac{3}{2} < \frac{7}{4} < \frac{15}{8} < 2$

Q3. Find out 6 rational numbers between 3 and 4

Solution:

Given that to find out 6 rational numbers between 3 and 4

We have,

$3 \times \frac{7}{7}$ = $\frac{21}{7}$ and

$4 \times \frac{6}{6}$ = $\frac{28}{7}$

We know 21 < 22 < 23 < 24 < 25 < 26 < 27 < 28

$$\frac{21}{7} < \frac{22}{7} < \frac{23}{7} < \frac{24}{7} < \frac{25}{7} < \frac{26}{7} < \frac{27}{7} < \frac{28}{7}$$
$$3 < \frac{22}{7} < \frac{23}{7} < \frac{24}{7} < \frac{25}{7} < \frac{26}{7} < \frac{27}{7} < 4$$

Therefore, 6 rational numbers between 3 and 4 are

$\frac{22}{7}, \frac{23}{7}, \frac{24}{7}, \frac{25}{7}, \frac{26}{7}, \frac{27}{7}$

Similarly to find 5 rational numbers between 3 and 4, multiply 3 and 4 respectively with $\frac{6}{6}$ and in order to find 8 rational numbers between 3 and 4 multiply 3 and 4 respectively with $\frac{8}{8}$ and so on.

Q4. Find 5 rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$

Solution : Given to find out the 5 rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$

To find 5 rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$, $\frac{3}{5}$ and $\frac{4}{5}$ with $\frac{6}{6}$

We have,

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

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

We know 18 < 19 < 20 < 21 < 22 < 23 < 24

$$\frac{18}{30} < \frac{19}{30} < \frac{20}{30} < \frac{21}{30} < \frac{22}{30} < \frac{23}{30} < \frac{24}{30}$$
$$\frac{3}{5} < \frac{19}{30} < \frac{20}{30} < \frac{21}{30} < \frac{22}{30} < \frac{23}{30} < \frac{4}{5}$$

Therefore, 5 rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$ are $\frac{19}{30}, \frac{20}{30}, \frac{21}{30}, \frac{22}{30}, \frac{23}{30}$

Q5. Answer whether the following statements are true or false? Give reasons in support of your answer.

(i) Every whole number is a rational 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) True. As whole numbers include and they can be represented

For example – $\frac{0}{10}, \frac{1}{1}, \frac{2}{1}, \frac{3}{1}$…. And so on.

(ii) True. As we know 1, 2, 3, 4 and so on, are integers and they can be represented in the form of $\frac{1}{1}, \frac{2}{1}, \frac{3}{1} \frac{4}{1}$.

(iii) False. Numbers such as $\frac{3}{2}, \frac{1}{2}, \frac{3}{5}, \frac{4}{5}$ are rational numbers but they are not integers.

(iv) True. Whole numbers include all of the natural numbers.

(v) False. As we know whole numbers are a part of integers.

(vi) False. Integers include -1, -2, -3 and so on….. .which is not whole number

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Chapter 1
Ex 1.2

Q1. Express the following rational numbers as decimals:

(i) $\frac{42}{100}$

(ii) $\frac{327}{500}$

(iii) $\frac{15}{4}$

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

Q2. Express the following rational numbers as decimals:

(i) $\frac{2}{3}$

(ii) $-\frac{4}{9}$

(iii) $-\frac{2}{15}$

(iv) $-\frac{22}{13}$

(v) $\frac{437}{999}$

Solution:

(i) By long division method

3) $\overline{2.0000}$ (0.66

18

$\overline{20}$

18

$\overline{2}$

Therefore, $\frac{2}{3}$ = 0.66

(ii) By long division method

9) $\overline{4.000}$ (0.444

3600

$\overline{4000}$

3600

$\overline{4000}$

3600

$\overline{400}$

Therefore, $-\frac{4}{9}$ = − 0.444

(iii) By long division method

15) $\overline{2.00}$ (1.333

15

$\overline{50}$

45

$\overline{50}$

45

50

45

5

Therefore, $\frac{2}{15}$ = -1.333

(iv) By long division method

13) $\overline{22.000}$ (1.69230769

13

90

78

120

117

30

26

40

39

100

91

90

78

120

117

3

Therefore, – $\frac{22}{13}$ = – 1.69230769

(v) By long division method

999) $\overline{437.0000}$ (0.43743

3996

3740

2997

7430

6993

4370

3996

3740

2997

743

Therefore, $\frac{437}{999}$ = 0.43743

Q3. Look at several examples of rational numbers in the form of $\frac{p}{q}$ (q ≠ 0), where p and q are integers with no common factor other than 1 and having terminating decimal representations. Can you guess what property q must satisfy?

Solution:

A rational number $\frac{p}{q}$ is a terminating decimal only, when prime factors of q are q and 5 only. Therefore, $\frac{p}{q}$ is a terminating decimal only, when prime factorization of q must have only powers of 2 or 5 or both.

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Chapter 1
Ex 1.3

Q1. Express each of the following decimals in the form of rational number.

(i) 0.39

(ii) 0.750

(iii) 2.15

(iv) 7.010

(v) 9.90

(vi) 1.0001

Solution:

(i) Given,

0.39 = $\frac{39}{100}$

(ii) Given,

0.750 = $\frac{750}{1000}$

(iii) Given,

2.15 = $\frac{215}{100}$ (iv) Given,9.101

(iv) Given,

7.010 = $\frac{7010}{1000}$

(v) Given,

9.90 = $\frac{990}{100}$

(vi) Given,

1.0001 = $\frac{10001}{10000}$

Q2. Express each of the following decimals in the form of rational number ($\frac{p}{q}$)

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

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

Solution:

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

Then, x = $0.\overline{4}$ = 0.444… ___ (a)

Multiplying both sides of equation (a) by 10, we get,

10x = 4.44…. ___ (b)

Subtracting equation (1) by (2)

9x = 4

$x = \frac{4}{9}$

Hence, 0. $\overline{4}$ = $x = \frac{4}{9}$

(ii) Let x = 0. $\overline{37}$

Then, x = 0. $\overline{37}$ = 0.3737… ___ (a)

Multiplying both sides of equation (a) by 100, we get,

100 x = 37.37…. ___ (b)

Subtracting equation (1) by (2)

99 x = 37

$x = \frac{37}{99}$

Hence, 0. $\overline{37}$ = $x = \frac{37}{99}$

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Chapter 1

Ex 1.4

Q1. Define an irrational number.

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.

Q2. Explain how an irrational number is differing 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, 0.10110100 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 $0.\overline{4}$ both are rational numbers

Q3. Find, whether the following numbers are rational and 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) $(\sqrt{2}+\sqrt{3})^2$

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

(x) $\sqrt{23}$

(xi) $\sqrt{225}$

(xii) 0.3796

(xiii) 7.478478……

(xiv) 1.101001000100001……

Solution:

(i) $\sqrt{7}$ is not a perfect square root so it is an Irrational

number.

(ii) $\sqrt{4}$ is a perfect square root so it is an rational number.

We have,

$\sqrt{4}$ can be expressed in the form of

$\frac{a}{b}$, so it is a rational number. The decimal

representation of $\sqrt{9}$ is 3.0. 3 is a rational number.

(iii) $2 + \sqrt{3}$

Here, 2 is a rational number and $\sqrt{3}$ is an irrational number

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

(iv) $\sqrt{3} + \sqrt{2}$

$\sqrt{3}$ is not a perfect square and it is an irrational number and $\sqrt{2}$ is not a perfect square and is an irrational number. The sum of an irrational number and an irrational number is an irrational number, so $\sqrt{3} + \sqrt{2}$ is an irrational number.

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

$\sqrt{3}$ is not a perfect square and it is an irrational number and $\sqrt{5}$ is not a perfect square and is an irrational number. The sum of an irrational number and an irrational number is an irrational number, so $\sqrt{3} + \sqrt{5}$ is an irrational number.

(vi) $(\sqrt{2}–2)^2$

We have, $(\sqrt{2}–2)^2$

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

$= 6 + 4\sqrt{2}$

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

The sum of a rational number and an irrational number is an irrational number, so $(\sqrt{2} + \sqrt{4})^2$ is an irrational number.

(vii) $(2–\sqrt{2})(2 + \sqrt{2})$

We have,

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

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

Since, 2 is a rational number.

$(2–\sqrt{2})(2 + \sqrt{2})$ is a rational number.

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

We have,

$(\sqrt{2} + \sqrt{3})^2 = 2 + 2\sqrt{6} + 3 = 5 + \sqrt{6}$ [Since, $(a+b)^2 = a^2 + 2ab + b^2$

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

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

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

$(\sqrt{5} - 2)$ is an irrational number.

(x) $\sqrt{23}$

$\sqrt{23}$ = 4.795831352331…

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

(xi) $\sqrt{225}$

$\sqrt{225} = 15 = \frac{15}{1}$

$\sqrt{225}$ is rational number as it can be represented in $\frac{p}{q}$ form.

(xii) 0.3796

0.3796, as decimal expansion of this number is terminating, so it is a rational number.

(xiii) 7.478478……

7.478478 = 7.478, as decimal expansion of this number is non-terminating recurring so it is a rational number.

(xiv) 1.101001000100001……

1.101001000100001……, as decimal expansion of this number is non-terminating, non-recurring so it is an irrational number

Q4. Identify the following as irrational numbers. Give the decimal representation of rational numbers:

(i) $\sqrt{4}$

(ii) $3 \times \sqrt{18}$

(iii) sqrt1.44

(iv) $\sqrt{\frac{9}{27}}$

(v) $-\sqrt{64}$

(vi) $\sqrt{100}$

Solution:

(i) We have,

$\sqrt{4}$ can be written in the form of

$\frac{p}{q}$. So, it is a rational number. Its decimal

representation is 2.0

(ii). We have,

$3 \times \sqrt{18}$,

$= 3 \times \sqrt{2x3x3}$

$= 9 \times \sqrt{2}$

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

$9 \times \sqrt{2}$is an irrational.

$3 \times \sqrt{18}$ is an irrational number.

(iii) We have,

sqrt1.44

$= \sqrt{\frac{144}{100}}$

$= \frac{12}{10}$

= 1.2

Every terminating decimal is a rational number, so 1.2 is a rational number.

Its decimal representation is 1.2.

(iv) $\sqrt{\frac{9}{27}}$

We have,

$\sqrt{\frac{9}{27}}$

$= \frac{3}{\sqrt{27}}$

$= \frac{1}{\sqrt{3}}$

Quotient of a rational and an irrational number is irrational numbers so

$\frac{1}{\sqrt{3}}$ is an irrational number.

$\sqrt{\frac{9}{27}}$ is an irrational number.

(v) We have,

$-\sqrt{64}$

$= -8$

$= -\frac{8}{1}$

$= -\frac{8}{1}$ can be expressed in the form of $\frac{a}{b}$,

so $-\sqrt{64}$ is a rational number.

Its decimal representation is – 8.0.

(vi) We have,

$\sqrt{100}$

= 10 can be expressed in the form of $\frac{a}{b}$,

so $\sqrt{100}$ is a rational number

Its decimal representation is 10.0.

Q5. In the following equations, find which variables x, y and z etc. represent rational or irrational numbers:

(i) $x^2 = 5$

(ii) $y^2 = 9$

(iii) $z^2 = 0.04$

(iv) $u^2 = \frac{17}{4}$

(v) $v^2 = 3$

(vi) $w^2 = 27$

(vii) $t^2 = 0.4$

Solution:

(i) We have,

$x^2 = 5$

Taking square root on both the sides, we get

$x = \sqrt{5}$

$\sqrt{5}$ is not a perfect square root, so it is an irrational number.

(ii) We have,

$=y^2 = 9$

= 3

$= \frac{3}{1}$ can be expressed in the form of $\frac{a}{b}$, so it a rational number.

(iii) We have,

$z^2 = 0.04$

Taking square root on the both sides, we get

z = 0.2

$\frac{2}{10}$ can be expressed in the form of $\frac{a}{b}$, so it is a rational number.

(iv) We have,

$u^2 = \frac{17}{4}$

Taking square root on both sides, we get,

u = $\sqrt{\frac{17}{4}}$

u = $\frac{\sqrt{17}}{2}$

Quotient of an irrational and a rational number is irrational, so u is an Irrational number.

(v) We have,

v^2 = 3

Taking square root on both sides, we get,

v = $\sqrt{3}$

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

(vi) We have,

w^2 = 27

Taking square root on both the sides, we get,

w = $3\sqrt{3}$

Product of a irrational and an irrational is an irrational number. So w is an irrational number.

(vii) We have,

t^2 = 0. 4

Taking square root on both sides, we get,

t = $\sqrt{\frac{4}{10}}$

t = $\frac{2}{\sqrt{10}}$

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

number. t^2 = 0.4 is an irrational number.

Q6. Give an example of each, of two irrational numbers whose:

(i) Difference in a rational number.

(ii) Difference in an irrational number.

(iii) Sum in a rational number.

(iv) Sum is an irrational number.

(v) Product in a rational number.

(vi) Product in an irrational number.

(vii) Quotient in a rational number.

(viii) Quotient in an irrational number.

Solution:

(i) $\sqrt{2}$ is an irrational number.

Now, $\sqrt{2} - \sqrt{2} = 0$.

0 is the rational number.

(ii) Let two irrational numbers are $3\sqrt{2}$ and $\sqrt{2}$.

$3\sqrt{2} - \sqrt{2} = 2\sqrt{2}$

$5\sqrt{6}$ is the rational number.

(iii) $\sqrt{11}$ is an irrational number.

Now, $\sqrt{11} + (-\sqrt{11}) = 0$.

0 is the rational number.

(iv) Let two irrational numbers are $4\sqrt{6}$ and $\sqrt{6}$

$4\sqrt{6} + \sqrt{6}$

$5\sqrt{6}$ is the rational number.

(iv) Let two Irrational numbers are $7\sqrt{5}$ and

$\sqrt{5}$

Now, $7\sqrt{5} \times \sqrt{5}$

$= 7 \times 5$

= 35 is the rational number.

(v) Let two irrational numbers are $\sqrt{8}$ and $\sqrt{8}$.

Now, $\sqrt{8} \times \sqrt{8}$

8 is the rational number.

(vi) Let two irrational numbers are $4\sqrt{6}$ and $\sqrt{6}$

Now, $\frac{4\sqrt{6}}{\sqrt{6}}$

= 4 is the rational number

(vii) Let two irrational numbers are $3\sqrt{7}$ and $\sqrt{7}$

Now, 3 is the rational number.

(viii) Let two irrational numbers are $\sqrt{8}$ and $\sqrt{2}$

Now $\sqrt{2}$ is an rational number.

Q7. Give two rational numbers lying between 0.232332333233332 and 0.212112111211112.

Solution: Let a = 0.212112111211112

And, b = 0.232332333233332…

Clearly, a < b because in the second decimal place a has digit 1 and b has digit 3 If we consider rational numbers in which the second decimal place has the digit 2, then they will lie between a and b.

Let. x = 0.22

y = 0.22112211… Then a < x < y < b

Hence, x, and y are required rational numbers.

Q8. Give two rational numbers lying between 0.515115111511115 and 0. 5353353335

Solution: Let, a = 0.515115111511115…

And, b = 0.5353353335..

We observe that in the second decimal place a has digit 1 and b has digit 3, therefore, a < b.

So If we consider rational numbers

x = 0.52

y = 0.52062062…

We find that,

a < x < y < b

Hence x and y are required rational numbers.

Q9. Find one irrational number between 0.2101 and 0.2222 … = $0.\overline{2}$

Solution:

Let, a = 0.2101 and,

b =0.2222…

We observe that in the second decimal place a has digit 1 and b has digit 2, therefore a < b in the third decimal place a has digit 0.

So, if we consider irrational numbers

x = 0.211011001100011….

We find that a < x < b

Hence x is required irrational number.

Q10. Find a rational number and also an irrational number lying between the numbers 0.3030030003… and 0.3010010001…

Solution: Let,

a=0.3010010001 and,

b = 0.3030030003…

We observe that in the third decimal place a has digit 1 and b has digit

3, therefore a < b in the third decimal place a has digit 1. So, if we

consider rational and irrational numbers x=0.302

y = 0.302002000200002…..

We find that a < x < b and, a < y < b.

Hence, x and y are required rational and irrational numbers respectively.

Q11. Find two irrational numbers between 0.5 and 0.55.

Solution: Let a = 0.5 = 0.50 and b =0.55

We observe that in the second decimal place a has digit 0 and b has digit 5, therefore a < 0 so, if we consider irrational numbers

x =0.51051005100051…

y = 0.530535305353530…

We find that a < x < y < b

Hence x and y are required irrational numbers.

Q12. Find two irrational numbers lying between 0.1 and 0.12.

Solution:

Let a = 0.1 =0.10

And b = 0.12

We observe that In the second decimal place a has digit 0 and b has digit 2.

Therefore, a < b.

So, if we consider irrational numbers

x = 0.1101101100011… y=0.111011110111110… We find that a < x < y < 0

Hence, x and y are required irrational numbers.

Q13. Prove that $\sqrt{3}+\sqrt{5}$ is an irrational number.

If possible, let $\sqrt{3}+\sqrt{5}$ be a rational number equal to x.

Then,

x= $\sqrt{3}+\sqrt{5}$

$x^2 = (\sqrt{3}+\sqrt{5})^2$

x^2 = 8 + $2\sqrt{15}$

$\frac{x^2-8}{2}$ = $\sqrt{15}$

Now, $\sqrt{\frac{x^2-8}{2}}$ is rational

$\sqrt{15}$ is rational

Thus, we arrive at a contradiction.

Hence, $\sqrt{3}+\sqrt{5}$ is an irrational number.