NTSE

NCERT Solutions for Class 9
MATHS – Number Systems

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

Sol. Yes. Zero is a rational number as it can be represented as $\dfrac{0}{1}$ or $\dfrac{0}{2}$ or $\dfrac{0}{3}$ etc.

2. Find six rational numbers between 3 and 4.

Sol. There are infinite rational numbers in between 3 and 4.

3 and 4 can be represented as $\dfrac{21}{7}$ and $\dfrac{28}{7}$ respectively.

Therefore, rational numbers between 3 and 4 are

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

3. 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.

Sol. (i) True; since the collection of real numbers is made up of rational and irrational numbers.
   (ii) False; as negative numbers cannot be expressed as the square root of any other number.
   (iii) False; as real numbers include both rational and irrational numbers. Therefore, every real number cannot be an irrational number.

4. 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.

Sol. If numbers such as $\sqrt{4} = 2, \sqrt{9} = 3$ are considered,

Then here, 2 and 3 are rational numbers. Thus, the square roots of all positive integers are not irrational.

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

   (i) $\dfrac{36}{100}$ (ii) $\dfrac{1}{11}$ (iii) $4\dfrac{1}{8}$ (iv) $\dfrac{3}{13}$

   (v) $\dfrac{2}{11}$ (vi) $\dfrac{329}{400}$

Sol. **(i)** $\dfrac{36}{100} = 0.36$ Terminating.

(ii) $\dfrac{1}{11} = 0.\overline{09}$, Recurring & Non-terminating.

(iii) $4\dfrac{1}{8} = 4.125$, Terminating.

(iv) $\dfrac{3}{13} = 0.\overline{230769}$, Recurring & Non-terminating.

(v) $\dfrac{2}{11} = 0.\overline{18}$, Recurring & Non-terminating.

(vi) $\dfrac{329}{400} = 0.8225$, Terminating.

6. You know that $\dfrac{1}{7} = 0.\overline{142857}$ Can you predict what the decimal expansions of $\dfrac{3}{2}, \dfrac{3}{7}, \dfrac{4}{7}, \dfrac{5}{7}, \dfrac{6}{7}$ are, without actually doing the long division? If so, how?

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

Sol. Without actual long division, the decimal expansions of $\dfrac{2}{7}, \dfrac{3}{7}, \dfrac{4}{7}, \dfrac{5}{7}, \dfrac{6}{7}$ are as follows:

$$\dfrac{2}{7} = 2 \times \dfrac{1}{7} = 2 \times 0.\overline{142857} = 0.\overline{285714}$$

$$\dfrac{3}{7} = 3 \times \dfrac{1}{7} = 3 \times 0.\overline{142857} = 0.\overline{428571}$$

$$\dfrac{4}{7} = 4 \times \dfrac{1}{7} = 4 \times 0.\overline{142857} = 0.\overline{571428}$$

$$\dfrac{5}{7} = 5 \times \dfrac{1}{7} = 5 \times 0.\overline{142857} = 0.\overline{714285}$$

$$\dfrac{6}{7} = 6 \times \dfrac{1}{7} = 6 \times 0.\overline{142857} = 0.\overline{857142}$$

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

(i) $0.\overline{6}$ (ii) $0.\overline{47}$ (iii) $0.\overline{001}$

Sol. **(i)** $0.\overline{6}$

Let $x = 0.\overline{6}$

$\Rightarrow x = 0.6666...$ …(i)

Multiplying equation (i) by 10 both sides

$10x = 6.6666...$

$\Rightarrow \quad 10x = 6 + 0.6666...$

$\Rightarrow \quad 10x = 6 + x \qquad$ [From equation (i)]

$\Rightarrow \quad 10x - x = 6$

$\Rightarrow \quad 9x = 6$

$\Rightarrow \quad x = \dfrac{6}{9} = \dfrac{2}{3}$

(ii) $0.\overline{47}$

Let $x = 0.\overline{47}$

$x = 0.47777... \qquad\qquad$ **…(i)**

Multiplying equation (i) by 10 both sides

$\Rightarrow 10x = 4.7777... \qquad\qquad$ …(ii)

Multiplying equation (ii) by 10 both sides

$100x = 47.7777...$

$\Rightarrow 100x = 43 + 4.7777...$

$\Rightarrow 100x = 43 + 10x \qquad\qquad$ [From equation (ii)]

$\Rightarrow 100x - 10x = 43$

$\Rightarrow 90x = 43$

$\Rightarrow x = \dfrac{43}{90}$

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

Let $x = 0.\overline{001}$

$\Rightarrow x = 0.001001001... \qquad\qquad$ …(i)

Multiplying equation (i) by 1000 both sides

$1000x = 1.001001001...$

$\Rightarrow \quad 1000x = 1 + 0.001001001...$

$\Rightarrow \quad 1000x = 1 + x \qquad\qquad$ [From equation (i)]

$\Rightarrow \quad 1000x - x = 1$

$\Rightarrow \quad 999x = 1$

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

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

Sol. 0.99999…

Let $x = 0.99999... \qquad\qquad$ …(1)

Multiplying equation (i) by 10 both sides

$10x = 9.99999...$

$\Rightarrow 10x = 9 + 0.99999...$

$\Rightarrow 10x = 9 + x$ [From equation (i)]

$\Rightarrow 10x - x = 9$

$\Rightarrow 9x = 9$

$\Rightarrow x = \dfrac{9}{9} = 1$

The answer makes sense as 0.99999… is very close to 1, that is why we can say that 0.99999 = 1.

9. Classify the following numbers as rational or irrational:

(i) $2 - \sqrt{5}$ (ii) $\left(3 + \sqrt{23}\right) - \sqrt{23}$ (iii) $\dfrac{2\sqrt{7}}{7\sqrt{7}}$

(iv) $\dfrac{1}{\sqrt{2}}$ (v) 2π

Sol. (i) $2 - \sqrt{5}$ Irrational number.

(ii) $(3 - \sqrt{23}) - \sqrt{23} = 3$ Rational number.

(iii) $\dfrac{2\sqrt{7}}{7\sqrt{7}} = \dfrac{2}{7}$ Rational number.

(iv) $\dfrac{1}{\sqrt{2}}$ Irrational number.

(v) 2π Irrational number.

10. Find:

(i) $64^{\frac{1}{2}}$ (ii) $32^{\frac{1}{5}}$ (iii) $125^{\frac{1}{3}}$

Sol. **(i)** $64^{\frac{1}{2}} = (8^2)^{\frac{1}{2}} = 8^{2 \times \frac{1}{2}} = 8$

(ii) $32^{\frac{1}{5}} = (2^5)^{\frac{1}{5}} = 2^{5 \times \frac{1}{5}} = 2$

(iii) $125^{\frac{1}{3}} = (5^3)^{\frac{1}{3}} = 5^{3 \times \frac{1}{3}} = 5$

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