

**CBSE Class 9 Mathematics**  
**NCERT Solutions**  
**CHAPTER 1**  
**Number Systems(Ex. 1.3)**

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)  $\frac{329}{400}$

Ans. (i)  $\frac{36}{100}$

On dividing 36 by 100, we get

$$\begin{array}{r} 0.36 \\ 100 \overline{) 36} \\ \underline{-0} \\ 360 \\ \underline{-300} \\ 600 \\ \underline{-600} \\ 0 \end{array}$$

Therefore, we conclude that  $\frac{36}{100} = 0.36$ , which is a terminating decimal.

(ii)  $\frac{1}{11}$

On dividing 1 by 11, we get

$$\begin{array}{r} 0.0909\ldots \\ 11 \overline{) 1} \\ \underline{-0} \\ 10 \\ \underline{-0} \\ 100 \\ \underline{-99} \\ 10 \\ \underline{-0} \\ 100 \\ \underline{-99} \\ 1 \end{array}$$

We can observe that while dividing 1 by 11, we got the remainder as 1, which will continue to be 1.

Therefore, we conclude that  $\frac{1}{11} = 0.0909\ldots$  or  $\frac{1}{11} = 0.\overline{09}$ , which is a non-terminating repeating decimal.

(iii)  $4\frac{1}{8} = \frac{33}{8}$

On dividing 33 by 8, we get

$$\begin{array}{r} 4.125 \\ 8 \overline{) 33} \\ \underline{-32} \\ 10 \\ \underline{-8} \\ 20 \\ \underline{-16} \\ 40 \\ \underline{-40} \\ 0 \end{array}$$

We can observe that while dividing 33 by 8, we got the remainder as 0.

Therefore, we conclude that  $4\frac{1}{8} = \frac{33}{8} = 4.125$ , which is a terminating decimal.

(iv)  $\frac{3}{13}$

On dividing 3 by 13, we get

$$\begin{array}{r} 0.230769.... \\ 13 \overline{) 3} \\ \underline{-0} \\ 30 \\ \underline{-26} \\ 40 \\ \underline{-39} \\ 10 \\ \underline{-0} \\ 100 \\ \underline{-91} \\ 90 \\ \underline{-78} \\ 120 \\ \underline{-117} \\ 3 \end{array}$$

We can observe that while dividing 3 by 13 we got the remainder as 3, which will continue to be 3 after carrying out 6 continuous divisions.

Therefore, we conclude that  $\frac{3}{13} = 0.230769.....$  or  $\frac{3}{13} = 0.\overline{230769}$ , which is a non-terminating repeating decimal.

(v)  $\frac{2}{11}$

On dividing 2 by 11, we get

$$\begin{array}{r}
 0.1818..... \\
 11 \overline{) 2} \\
 \underline{-0} \\
 20 \\
 \underline{-11} \\
 90 \\
 \underline{-88} \\
 20 \\
 \underline{-11} \\
 90 \\
 \underline{-88} \\
 2
 \end{array}$$

We can observe that while dividing 2 by 11, first we got the remainder as 2 and then 9, which will continue to be 2 and 9 alternately.

Therefore, we conclude that  $\frac{2}{11} = 0.1818.....$  or  $\frac{2}{11} = 0\overline{18}$ , which is a non-terminating repeating decimal.

(vi)  $\frac{329}{400}$

On dividing 329 by 400, we get

$$\begin{array}{r}
 0.8225 \\
 400 \overline{) 329} \\
 \underline{-0} \\
 3290 \\
 \underline{-3200} \\
 900 \\
 \underline{-800} \\
 1000 \\
 \underline{-800} \\
 2000 \\
 \underline{-2000} \\
 0
 \end{array}$$

We can observe that while dividing 329 by 400, we got the remainder as 0.

Therefore, we conclude that  $\frac{329}{400} = 0.8225$ , which is a terminating decimal.

2. You know that  $\frac{1}{7} = 0.142857.....$ . 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?

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

**Ans.** We are given that  $\frac{1}{7} = 0.\overline{142857}$  or  $\frac{1}{7} = 0.142857.....$ .

We need to find the values of  $\frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}$  and  $\frac{6}{7}$ , without performing long division.

We know that,  $\frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}$  and  $\frac{6}{7}$  can be rewritten as  $2 \times \frac{1}{7}, 3 \times \frac{1}{7}, 4 \times \frac{1}{7}, 5 \times \frac{1}{7}$  and  $6 \times \frac{1}{7}$ .

On substituting value of  $\frac{1}{7}$  as  $0.142857.....$ , we get

$$2 \times \frac{1}{7} = 2 \times 0.142857..... = 0.285714.....$$

$$3 \times \frac{1}{7} = 3 \times 0.142857.... = 0.428571.....$$

$$4 \times \frac{1}{7} = 4 \times 0.142857... = 0.571428.....$$

$$5 \times \frac{1}{7} = 5 \times 0.142857..... = 0.714285.....$$

$$6 \times \frac{1}{7} = 6 \times 0.142857..... = 0.857142.....$$

Therefore, we conclude that, we can predict the values of  $\frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}$  and  $\frac{6}{7}$ , without performing long division, to get

$$\frac{2}{7} = 0.\overline{285714}, \frac{3}{7} = 0.\overline{428571}, \frac{4}{7} = 0.\overline{571428}, \frac{5}{7} = 0.\overline{714285}, \text{ and } \frac{6}{7} = 0.\overline{857142}$$

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)  $0.\overline{001}$

**Ans.** Solution:

(i) Let  $x = 0.\overline{6} \Rightarrow x = 0.6666\ldots(a)$

We need to multiply both sides by 10 to get

$$10x = 6.6666\ldots \quad \ldots(b)$$

We need to subtract (a) from (b), to get

$$\begin{array}{r} 10x = 6.6666\ldots \\ - x = 0.6666\ldots \\ \hline 9x = 6 \end{array}$$

We can also write  $9x = 6$  as  $x = \frac{6}{9}$  or  $x = \frac{2}{3}$ .

Therefore, on converting  $0.\overline{6}$  in the  $\frac{p}{q}$  form, we get the answer as  $\frac{2}{3}$ .

(ii) Let  $x = 0.4\overline{7} \Rightarrow x = 0.47777\ldots(a)$

We need to multiply both sides by 10 to get

$$10x = 4.7777\ldots(b)$$

We need to subtract (a) from (b), to get

$$\begin{array}{r} 10x = 4.7777..... \\ - x = 0.4777.... \\ \hline 9x = 4.3 \end{array}$$

We can also write  $9x = 4.3$  as  $x = \frac{4.3}{9}$  or  $x = \frac{43}{90}$ .

Therefore, on converting  $0.4\bar{7}$  in the  $\frac{p}{q}$  form, we get the answer as  $\frac{43}{90}$ .

(iii) Let  $x = 0.\overline{001} \Rightarrow x = 0.001001.....(a)$

We need to multiply both sides by 1000 to get

$$1000x = 1.001001..... \quad \dots(b)$$

We need to subtract (a) from (b), to get

$$\begin{array}{r} 1000x = 1.001001..... \\ - x = 0.001001.... \\ \hline 999x = 1 \end{array}$$

We can also write  $999x = 1$  as  $x = \frac{1}{999}$ .

Therefore, on converting  $0.\overline{001}$  in the  $\frac{p}{q}$  form, we get the answer as  $\frac{1}{999}$ .

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

**Ans.** Let  $x = 0.99999.....(a)$

We need to multiply both sides by 10 to get

$$10x = 9.9999.....(b)$$

We need to subtract (a) from (b), to get

$$\begin{array}{r} 10x = 9.9999..... \\ - x = 0.9999..... \\ \hline 9x = 9 \end{array}$$

We can also write  $9x = 9$  as  $x = \frac{9}{9}$  or  $x = 1$ .

Therefore, on converting  $0.99999.....$  in the  $\frac{p}{q}$  form, we get the answer as 1.

Yes, at a glance we are surprised at our answer.

But the answer makes sense when we observe that  $0.9999.....$  goes on forever. SO there is not gap between 1 and  $0.9999.....$  and hence they are equal.

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

**Ans.** We need to find the number of digits in the recurring block of  $\frac{1}{17}$ .

Let us perform the long division to get the recurring block of  $\frac{1}{17}$ .

We need to divide 1 by 17, to get

We can observe that while dividing 1 by 17 we got the remainder as 1, which will continue to be 1 after carrying out 16 continuous divisions.

Therefore, we conclude that



$\frac{1}{17} = 0.0588235294117647.....$  or  $\frac{1}{17} = 0.\overline{0588235294117647}$ , which is a non-terminating decimal and recurring decimal.

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?

**Ans.** Solution:

Let us consider the examples of the form  $\frac{p}{q}$  that are terminating decimals.

$$\frac{5}{2} = 2.5$$

$$\frac{5}{4} = 1.25$$

$$\frac{2}{5} = 0.4$$

$$\frac{2}{10} = 0.2$$

$$\frac{5}{16} = 0.3125$$

We can observe that the denominators of the above rational numbers have powers of 2, 5 or both.

Therefore, we can conclude that the property, which  $q$  must satisfy in  $\frac{p}{q}$ , so that the rational

number  $\frac{p}{q}$  is a terminating decimal is that  $q$  must have powers of 2, 5 or both.

*is not equal to*

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

**Ans.** The three numbers that have their expansions as non-terminating on recurring decimal are given below.

0.04004000400004....

0.07007000700007....

0.013001300013000013....

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

**Ans.** Let us convert  $\frac{5}{7}$  and  $\frac{9}{11}$  into decimal form, to get

$$\frac{5}{7} = 0.714285.... \text{ and } \frac{9}{11} = 0.818181....$$

Three irrational numbers that lie between 0.714285.... and 0.818181.... are:

0.73073007300073....

0.74074007400074....

0.76076007600076....

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

(i)  $\sqrt{23}$

(ii)  $\sqrt{225}$

(iii) 0.3796

(iv) 7.478478...

(v) 1.101001000100001...

Ans. (i)  $\sqrt{23}$

We know that on finding the square root of 23, we will not get an integer.

Therefore, we conclude that  $\sqrt{23}$  is an irrational number.

(ii)  $\sqrt{225}$

We know that on finding the square root of 225, we get 15, which is an integer.

Therefore, we conclude that  $\sqrt{225}$  is a rational number.

(iii) 0.3796

We know that 0.3796 can be converted into  $\frac{p}{q}$ .

While, converting 0.3796 into  $\frac{p}{q}$  form, we get

$$0.3796 = \frac{3796}{10000}.$$

The rational number  $\frac{3796}{10000}$  can be converted into lowest fractions, to get  $\frac{949}{2500}$ .

We can observe that 0.3796 can be converted into a rational number.

Therefore, we conclude that 0.3796 is a rational number.

(iv) 7.478478....

We know that 7.478478.... is a non-terminating recurring decimal, which can be converted into  $\frac{p}{q}$  form.

While, converting 7.478478.... into  $\frac{p}{q}$  form, we get

$$x = 7.478478.... \quad \dots (a)$$

$$1000x = 7478.478478..... (b)$$

While, subtracting (b) from (a), we get

$$\begin{array}{r} 1000x = 7478.478478.... \\ - x = 7.478478.... \\ \hline 999x = 7471 \end{array}$$

We know that  $999x = 7471$  can also be written as  $x = \frac{7471}{999}$ .

Therefore, we conclude that 7.478478.... is a rational number.

**(v)** 1.101001000100001....

We can observe that the number 1.101001000100001.... is a non-terminating on recurring decimal.

We know that non-terminating and non-recurring decimals cannot be converted into  $\frac{p}{q}$  form.

Therefore, we conclude that 1.101001000100001.... is an irrational number.