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NUMBER WORLD



Number that Counts

You've learnt many things about numbers. Which is the largest number you know?

Aren't there numbers after that?

It is easy to start from the smallest number and make it bigger and bigger. See.

1	One
10	Ten
100	Hundred
1000	Thousand
10000	Ten thousand

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How do the numbers become larger as we write like this?

Every time the digit 1 shifts one place to the left, it becomes ten times as large:

Ten Thousand	Thousand	Hundred	Ten	One
				1
			1	0
		1	0	0
	1	0	0	0
1	0	0	0	0

So can't we shift 1 still further left and make larger numbers?

Sure we can:

100000 Lakh

1000000 Ten lakh

10000000 Crore

Crore	Ten Lakh	Lakh	Ten Thousand	Thousand	Hundred	Ten	One
		1	0	0	0	0	0
	1	0	0	0	0	0	0
1	0	0	0	0	0	0	0

Adding more zeros, we can continue like ten crores, hundred crores and so on.

In other countries these numbers are known by different names.

100000 Hundred thousand

1000000 Million

10000000 Ten million

100000000 Hundred million

1000000000 Billion

Reading numbers

There's another way to read 362880. Start from the right with 0 and count places to the left as one, ten, hundred and so on:

- 0 One
- 8 Ten
- 8 Hundred
- 2 Thousand
- 6 Ten thousand
- 3 Lakh

Then the number can be read as "Three lakh, sixty two thousand eight hundred eighty".

For example, the number obtained by multiplying all one-digit numbers from one to nine is 362880 (You can check this, if you have the patience. You can also see how the products increase as you go on multiplying by the succeeding numbers one by one)

How do we read this?

We can start from the left:

- 3 Three
- 36 Thirty six
- 362 Three hundred sixty two

- 3628 Three thousand six hundred twenty eight
- 36288 Thirty six thousand two hundred eighty eight
- 362880 Three lakh sixty two thousand eight hundred eighty

Lakh	Ten Thousand	Thousand	Hundred	Ten	One
					3
				3	6
			3	6	2
		3	6	2	8
	3	6	2	8	8
3	6	2	8	8	0

We can also read numbers by counting digits:

- One-digit numbers 1 to 9
- Two-digit numbers 10 to 99
- Three-digit numbers 100 to 999
- Four-digit numbers 1000 to 9999
- Five-digit numbers 10000 to 99999
- Six-digit numbers 100000 to 999999
- Seven-digit numbers 1000000 to 9999999

And we can continue

So how do we read 234567 ? Since it is a six-digit number, it is more than a lakh

Thus we read

Two lakh

.....

Can you read the statements below?

1. In 2023, the minimum distance between the Earth and the Moon is 356569 kilometres and the maximum is 406458 kilometres.
2. According to the 2011 census, the population of Kerala was 33406061 and the total population of India was 1210854977.
3. The product of all the numbers from 1 to 11 is 39916800.

Growing numbers

There are only nine one-digit numbers, 1, 2, 3, ..., 9.

How many two-digit numbers are there?

That is, numbers from 10 to 99

Is it $99 - 10 = 89$?

Let's think:

- There are 99 numbers from 1 to 99
- We have to remove the one-digit numbers 1 to 9 from these

Planet distance

The table shows the minimum and maximum distance of the planets from the Sun, as they orbit around it.



Planet	Distance (Km)	
	Minimum	Maximum
Mercury	46375340	70310999
Venus	107710467	109206446
Earth	146605913	152589828
Mars	206445062	249828444
Jupiter	746509460	815308395
Saturn	1347876815	1506450558
Uranus	2734649076	3005421222
Neptune	4458016547	4535807440

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- So $99 - 9 = 90$ numbers.

Like this, can't we calculate how many three-digit numbers are there? From the numbers 1 to 999 we have to remove those from 1 to 99

$$999 - 99 = 900$$

Let's look at another problem.

First a simple question: how many two-digit numbers are there having both the digits 1 and 3? Just 13 and 31, right?

Okay! How many three-digit numbers have the three digits 1, 3, 5?

Don't start counting yet! Let's think a bit (Thinking before doing is the math motto)

We have seen how many two-digit numbers combining 1 and 3. How can we attach 5 to 1 and 3 to make maximum three-digit numbers?

For example let's consider 13

When 5 is placed in front of 1 and 3, we get



When 5 is placed between 1 and 3, we get



When 5 is placed after 1 and 3, we get



Like this, we can attach 5 into 31 also in three different ways:

When 5 is placed before 3 and 1, we get



When 5 is placed between 3 and 1, we get



When 5 is placed after 3 and 1, we get



Altogether we can make 6 three-digit numbers using 1, 3 and 5.



So how many four-digit numbers are possible with 1, 3, 5, 7 as the digits?

How do we think about this?

- How many three-digit numbers with digits 1, 3, 5?
- In each, what are the different positions where we can attach 7?
- How many numbers do you get?

If you got the answer as $4 \times 6 = 24$, your reasoning is correct.

If you have got a different answer you've to rethink the method you have used to find the three-digits and re-read the questions. Now can't you find how many four-digit numbers are there with digits 1, 3, 4, 5 ?

How many nine-digit numbers are possible using digits 1 to 9 ?

Once you've thought about the method, before starting to multiply to calculate the actual number, recall that this product is given somewhere in the first part of this lesson.

Have you noticed that in all these problems, we haven't used the digit 0 ? Why?

For example, how do we compute the number of three-digit numbers with digits 0, 1, 3 ? What changes should you make in the earlier calculations using 1, 3, 5 ?

0 cannot be the first digit.

So in each of 13 and 31, we can attach 0 only at two positions. So, the number of two-digit numbers is $2 \times 2 = 4$.

How many four-digit numbers are possible using all the digits 0, 1, 3, 5 ?

- 6 three-digit numbers are possible with digits 1, 3, 5.
- 0 can be attached at three different positions in each.
- Altogether $3 \times 6 = 18$.

Sum and product

Two lists of numbers to be added:

100000000 +
 120000000
 123000000
 123400000
 123450000
 123456000
 123456700
 123456780
 123456789

1 +
 21
 321
 4321
 54321
 654321
 7654321
 87654321
 987654321

Which sum is larger ?

If you note that

$$9 \times 1 = 1 \times 9$$

$$8 \times 2 = 2 \times 8$$

$$7 \times 3 = 3 \times 7$$

.....

then you can get the answer without actually adding the numbers

Kaprekar number

Start with any four digits and find the largest and smallest four-digit numbers using all these. For example, if we take 2, 3, 5, 6

Largest number 6532

Smallest number 2356

Their difference

$$6532 - 2356 = 4176$$

Now if we repeat the procedure with the digits of this difference, we get

$$7641 - 1467 = 6174$$

What happens if we repeat procedure with the digits of 6174?

Take any other four digits and check. Do you get 6174 after some steps?

This was discovered by the Indian mathematician Kaprekar, who was a school teacher in Maharashtra. So this number, 6174 is known as Kaprekar number.



We can think in other ways too:

- There are 24 four-digit numbers with 1, 3, 5, 7 as the digits
- 7 is the first digit in 6 of them
- If we take 0 instead of 7, these 6 numbers have no counterparts
- So there are $24 - 6 = 18$ numbers



Now try these:

1. How many two-digit numbers are there with 0? How many without 0?
2.
 - i. How many three-digit numbers are possible with two 0?
 - ii. How many three-digit numbers are there with only one 0?
 - iii. How many three-digit numbers are there without any zero?
3. How many two-digit numbers are there with the same digit repeated? How many three-digit numbers with the same digit repeated thrice?
4. There are some numbers which read the same when the digits are put in the reverse order. For example, 46764. Such numbers are called palindromic numbers.
 - i. How many two-digit numbers are palindromes?
 - ii. How many three-digit numbers?
 - iii. Four-digit numbers?
5. How many four-digit numbers can be made using all the digits 1, 2, 3, 4? What is the sum of all these?