



1B: Powers of ten

$$1 = 10^0$$

$$10 = 10^1$$

$$100 = 10 \times 10 = 10^2$$

$$1\,000 = 10 \times 10 \times 10 = 10^3$$

$$10\,000 = 10 \times 10 \times 10 \times 10 = 10^4$$

$10^0, 10^1, 10^2, 10^3, 10^4 \dots$ are called **powers of ten**.

The little 1, 2, 3, 4 of $10^1, 10^2, 10^3, 10^4 \dots$ are called **exponents**.



The place value chart shows the *base 10* number system. Each place value is a **power of 10**. Each place to the left of a number is one power of ten bigger or ten times bigger.

(Thousands of millions) Billions	MILLIONS			THOUSANDS			ONES		
	Hundreds of millions	Tens of millions	Millions	Hundreds of thousands	Tens of thousands	Thousands	Hundreds	Tens	Ones
10^9	10^8	10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0

Exponent form uses powers of 10 to indicate place value.

Note 1 billion is a thousand million (10^9).

The base 10 number system extends infinitely right **and** left.

10^2 is said as

"10 to the power of 2, or 10 to the second power"

3 605 can be written as $3 \times 1\,000 + 6 \times 100 + 5 \times 1 = 3 \times 10^3 + 6 \times 10^2 + 5 \times 10^0$.

Example

- 1** The earth is about one hundred and forty-nine million, six hundred thousand kilometres from the sun.

This is written as 149 600 000 km.



Worked examples

- 1** Write, in figures, the number that is 4 more than one and a half million.

Answer One and a half million is 1 500 000.

4 more than this is 1 500 004.

- 2** Write 8 769 083 using powers of 10.

Answer $8\,769\,083 = 8 \times 10^6 + 7 \times 10^5 + 6 \times 10^4 + 9 \times 10^3 + 8 \times 10^1 + 3 \times 10^0$

Activity 2

1 Write these without the exponent.

a 10^2 **b** 10^4 **c** 10^1 **d** 10^3 **e** 10^8 **f** 10^9 **g** 10^{11}

2 Write these as a power of ten.

a a thousand **b** a million **c** a hundred **d** a hundred thousand
e ten million **f** a billion **g** ten **h** ten billion

3 Write as numbers, or say the numbers, in **red**.

- a** A heart beats about **37 000 000** times each year.
b The average person will blink about **5 625 000** times each year.
c One megabyte is **1 048 576** bytes.
d The African continent has an area of **30 271 000** km².
e The galaxy NGC2207 is **114 100 000** light years from Earth.



4 Write the numbers in **red** using expanded powers of 10.



- a** The world's highest observatory is **4 300** m above sea level.
b Saturn's rings are **2 700** km in diameter.
c Jupiter's largest moon is **5 262** km in diameter.
d Jupiter's largest moon is **107 000** km from Jupiter.
e Saturn is **1 427 000 000** km from the Sun.
f Neptune takes a bit more than **160** Earth years to orbit the Sun.
g Neptune's largest moon is **2 710** km in diameter.
h Neptune is **4 497 000 000** km from the Sun.

Puzzle

I am a 6-digit number between 400 and 500.

All of my digits are different.

The difference between my ones digit and my thousandths digit is the same as the difference between my tens digit and my hundredths digit.

My tenths digit is three times my hundredths digit.

My ones digit is twice my tenths digit.

The sum of my digits is 21.

What number am I?



My first digit must be 4.

