

## POWERS OF 10

We use the metric system of measurement in Australia. The metric system is based on powers of ten. Before continuing with our study of the metric system, we need to revise the powers of 10.

The powers of ten are 10, 100, 1000, 10 000, 100 000, 1 000 000 and so on.

### INDIVIDUAL ACTIVITY NAMING THE POWERS OF 10

Copy this table into your exercise book. Complete second column of this table. Leave the third column blank for now.

Number	Name	Power
10	ten	
100	one hundred	
1000	one thousand	
10 000	ten thousand	
100 000		
1 000 000		
10 000 000		
100 000 000		
1 000 000 000		
10 000 000 000		
100 000 000 000		
1 000 000 000 000		

10	is the <b>base</b> of our number system. Sometimes 10 is called the first power of 10.
100 = 10 × 10	we say, “100 equals 10 squared” or “100 equals 10 to the power of 2”.
1000 = 10 × 10 × 10	we say, “1000 equals 10 cubed” or “1000 equals 10 to the power of 3”.
10 000 = 10 × 10 × 10 × 10	we say, “10 000 equals 10 to the power of 4”.
100 000 = 10 × 10 × 10 × 10 × 10	we say, “100 000 equals 10 to the power of 5”.
1 000 000 = 10 × 10 × 10 × 10 × 10 × 10	we say, “1 000 000 equals 10 to the power of 6”.

and so on.

We have a shorthand method of writing powers of ten:

10 =	$10^1$	since there is only one factor of 10.
100 = 10 × 10 =	$10^2$	since there are two factors of 10.
1000 = 10 × 10 × 10 =	$10^3$	since there are three factors of 10.

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1 000 000 = 10 × 10 × 10 × 10 × 10 × 10 =	$10^6$	since there are six factors of 10.
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We can continue on forever.

The small number is called the **index**. This method of writing numbers is called **index notation**. Sometimes we read  $10^6$  as “10 to the power of 6” and sometimes we read it as “10 to the index 6”.

## INDIVIDUAL ACTIVITY THE POWERS OF 10

- Now complete the third column of your table, writing the powers of 10 using index notation.
- There is a simple pattern connecting the number of zeros in the power of ten to the index. What is it?
- Write this power of ten using an index: 10 000 000 000 000 000 000.
- Write this power of ten as a normal number:  $10^{17}$ .

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## GROUP ACTIVITY MULTIPLYING AND DIVIDING BY POWERS OF TEN

- a. Every number has a decimal point, but sometimes it isn't shown. Where is the decimal point in:

243

5

427

- b. Do these on your calculator:

$2 \times 10 = \underline{\quad}$

$5 \times 100 = \underline{\quad}$

$3 \times 1000 = \underline{\quad}$

$2.5 \times 10 = \underline{\quad}$

$5.6 \times 100 = \underline{\quad}$

$\underline{\quad} \times 3.4 \times 1000 = \underline{\quad}$

$2.57 \times 10 = \underline{\quad}$

$5.62 \times 100 = \underline{\quad}$

$\underline{\quad} \times 3.879 \times 10\,000 = \underline{\quad}$

- c. Use the pattern in the above answer to find a quick method of multiplying by a power of 10. Write the rule you have discovered.

- d. Do these on your calculator:

$200 \div 10 = \underline{\quad}$

$500 \div 100 = \underline{\quad}$

$\underline{\quad} \times 3000 \div 1000 = \underline{\quad}$

$250 \div 10 = \underline{\quad}$

$560 \div 100 = \underline{\quad}$

$\underline{\quad} \times 3400 \div 1000 = \underline{\quad}$

$257 \div 10 = \underline{\quad}$

$562 \div 100 = \underline{\quad}$

$\underline{\quad} \times 3879 \div 10\,000 = \underline{\quad}$

- e. Use the pattern in the above answer to find a quick method of dividing by a power of 10. Write the rule you have discovered.

- f. Answer these without a calculator.

i.  $42.5 \times 100$

ii.  $0.349 \times 1000$  iii.  $1.06 \times 100\,000$

iv.  $32\,000 \div 10$

v.  $92.45 \div 1000$  vi.  $0.45 \div 100$

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In the above activity, you might have discovered these useful rules for multiplying by powers of ten:

<p>To multiply by 10, move the decimal point one place to the right</p> <p>To multiply by 100, move the decimal point two places to the right.</p> <p>To multiply by <i>any</i> power of 10,</p> <ul style="list-style-type: none"><li>count the number of zeros in the power of ten</li><li>move the decimal point that many places to the right.</li></ul>
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You might also have discovered these useful rules for dividing by powers of ten:

To divide by 10, move the decimal point one place to the left.  
To divide by 100, move the decimal point two places to the left.  
To divide by *any* power of 10,

- count the number of zeros in the power of ten
- move the decimal point that many places to the left.


### Example 4.1

- a. Multiply:  $0.34 \times 10\,000$   
b. Divide:  $2.3 \div 1000$

### Solution

- a. There are 4 zeros in 10 000. We need to move the decimal point 4 places to the right.

We add two zeros as place holders.

0.3400  


The answer is:  $0.34 \times 10\,000 = 3400$

- b. There are 3 zeros in 1000. We need to move the decimal point 3 places to the left.

We add two zeros as a place holder.

002,3  


The answer is:  $2.3 \div 1000 = 0.0023$

### Exercise 4B

- Write the name of each of these numbers.
  - 1 000 000
  - 1 000 000 000
- Write each of these using index notation.
  - 1 000
  - 1 000 000 000 000
- Write each of these as a normal number.
  - $10^5$
  - $10^7$
- Write the name of each of these numbers.
  - $10^4$
  - $10^8$
- Multiply, without using a calculator.
  - $30 \times 1000$
  - $3.4 \times 100$
  - $4.28 \times 1000\,000$
  - $0.6 \times 1000$
  - $123.5 \times 100$
  - $0.023 \times 1000\,000$
- Divide, without using a calculator.
  - $8\,000 \div 10$
  - $42\,000 \div 1000$
  - $45 \div 100$
  - $0.7 \div 10$
  - $452\,000 \div 1\,000\,000$
  - $0.6 \div 100$