

WALT understand and work with scientific notation  
 Success Criteria I know it's based on the power of 10  
[Video on Scientific notation](#)

### Example 1

State whether or not the following numbers are written in scientific notation.  
**a**  $6.7 \times 10^8$       **b**  $23 \times 10^5$       **c**  $3.65 \times 1000$       **d**  $2.96 \times 10^{-7}$       **e** 480 000

	Solve	Think	Apply
<b>a</b>	Yes	The first number (6.7) is between 1 and 10 and it is multiplied by a power of 10 ( $10^8$ ).	A number is written in scientific notation if it is expressed as the product of a number between 1 and 10 and a power of 10.
<b>b</b>	No	The first number (23) is not between 1 and 10.	
<b>c</b>	No	The second number (1000) is not expressed as a power of 10.	
<b>d</b>	Yes	The first number (2.96) is between 1 and 10 and it is multiplied by a power of 10 ( $10^{-7}$ ).	
<b>e</b>	No	The number is not written as a product.	

**1** State whether or not the following numbers are written in scientific notation.

- a**  $5.9 \times 10^6$       **b**  $34 \times 10^8$       **c**  $8.97 \times 10\ 000$       **d**  $5.03 \times 10^{-9}$   
**e** 28 000      **f**  $7 \times 10^{-15}$       **g**  $0.85 \times 10^4$       **h**  $4.2 \times 100$   
**i** 163 000 000      **j**  $2.006 \times 10^{68}$

**2** Complete this table.

$10^0$	$10^1$	$10^2$		$10^4$	$10^5$	
1	10		1000			1 000 000

### Example 2

Write the following numbers in scientific notation.  
**a** 5 000 000      **b** 40 000

	Solve/Think	Apply
<b>a</b>	$5\ 000\ 000 = 5 \times 1\ 000\ 000$ $= 5 \times 10^6$ using the table in question 2	Write the number as the product of a number between 1 and 10 and a multiple of 10. Then express the multiple of 10 as a power of 10.
<b>b</b>	$40\ 000 = 4 \times 10\ 000$ $= 4 \times 10^4$	

**3** Write the following numbers in scientific notation.

- a** 3 000 000      **b** 70 000      **c** 8000      **d** 600 000      **e** 500

### Example three

Write the following numbers in scientific notation.

**a** 5300

**b** 284 000

	Solve/Think	Apply
<b>a</b>	$5300 = 5.3 \times 1000$ $= 5.3 \times 10^3$	Write the number as the product of a number between 1 and 10 and a multiple of 10. Then express the multiple of 10 as a power of 10.
<b>b</b>	$284\,000 = 2.84 \times 100\,000$ $= 2.84 \times 10^5$	

**4** Write the following numbers in scientific notation.

**a** 4800

**b** 392 000

**c** 64 000

**d** 2 180 000

**e** 760

### Example 4

Write the following numbers as ordinary decimal numbers.

**a**  $6 \times 10^5$

**b**  $3.94 \times 10^6$

	Solve/Think	Apply
<b>a</b>	$6 \times 10^5 = 6 \times 100\,000$ $= 600\,000$	Express the power of 10 as a multiple of 10 and perform the multiplication.
<b>b</b>	$3.94 \times 10^6 = 3.94 \times 1\,000\,000$ $= 3\,940\,000$	

**5** Write the following numbers as ordinary decimal numbers.

**a**  $3 \times 10^4$

**b**  $7 \times 10^3$

**c**  $9 \times 10^6$

**d**  $4 \times 10^5$

**e**  $8 \times 10^2$

**f**  $4.6 \times 10^5$

**g**  $6.71 \times 10^3$

**h**  $3.9 \times 10^6$

**i**  $8.36 \times 10^4$

**j**  $5.2 \times 10^5$

**6** Complete this table.

0.1	0.01		0.0001		0.000 001
$\frac{1}{10}$		$\frac{1}{1000}$		$\frac{1}{100\,000}$	

### Example 5

Write the following numbers in scientific notation.

**a** 0.004

**b** 0.000 009

	Solve/Think	Apply
<b>a</b>	$\begin{aligned} 0.004 &= 4 \times 0.001 \\ &= 4 \times \frac{1}{1000} \\ &= 4 \times \frac{1}{10^3} \\ &= 4 \times 10^{-3} \end{aligned}$	Write the number as the product of a number between 1 and 10 and a decimal fraction. Express the decimal fraction as a power of 10.
<b>b</b>	$\begin{aligned} 0.000\ 009 &= 9 \times 0.000\ 001 \\ &= 9 \times \frac{1}{1\ 000\ 000} \\ &= 9 \times \frac{1}{10^6} \\ &= 9 \times 10^{-6} \end{aligned}$	

**7** Write the following numbers in scientific notation.

**a** 0.003

**b** 0.000 007

**c** 0.0005

**d** 0.000 02

**e** 0.09

Example six

Write as ordinary decimal numbers.

**a**  $5 \times 10^{-2}$

**b**  $7 \times 10^{-6}$

	Solve/Think	Apply
<b>a</b>	$\begin{aligned} 5 \times 10^{-2} &= 5 \times \frac{1}{10^2} \\ &= 5 \times 0.01 \\ &= 0.05 \end{aligned}$	Express the power of 10 as a decimal fraction and perform the multiplication.
<b>b</b>	$\begin{aligned} 7 \times 10^{-6} &= 7 \times \frac{1}{10^6} \\ &= 7 \times 0.000\ 001 \\ &= 0.000\ 007 \end{aligned}$	

**8** Write the following as ordinary decimal numbers.

**a**  $6 \times 10^{-2}$

**b**  $3 \times 10^{-6}$

**c**  $2 \times 10^{-3}$

**d**  $5 \times 10^{-4}$

**e**  $9 \times 10^{-6}$

### Example 7

Explain the difference between:

**a**  $2 \times 10^4$  and  $2^4$

**b**  $2 \times 10^{-4}$  and  $2^{-4}$

	Solve/Think	Apply
<b>a</b>	$2 \times 10^4 = 2 \times 10\,000$ $= 20\,000$ $2^4 = 2 \times 2 \times 2 \times 2$ $= 16$	Evaluate each numerical expression to show the difference.
<b>b</b>	$2 \times 10^{-4} = 2 \times \frac{1}{10^4}$ $= 2 \times \frac{1}{10\,000}$ $= 2 \times 0.0001$ $= 0.0002$ $2^{-4} = \frac{1}{2^4} = \frac{1}{16}$ $= 0.0625$	

**9** Explain the difference between:

**a**  $3 \times 10^4$  and  $3^4$

**b**  $5 \times 10^{-2}$  and  $5^{-2}$

**c**  $2 \times 10^3$  and  $2^3$


**d**  $2 \times 10^{-5}$  and  $2^{-5}$

**e**  $4 \times 10^6$  and  $4^6$

**f**  $5 \times 10^6$  and  $5^6$

### Example 8

Write 246 000 in scientific notation.

Solve	Think	Apply
$246\,000 = 2.46 \times 10^5$	<p>A quick method for writing in scientific notation is:</p> <p><i>Step 1:</i> Move the decimal point so that it is after the first non-zero digit of the number. This produces a number between 1 and 10. In this case it is 2.460 00.</p> <p><i>Step 2:</i> Count the number of places back to the original position of the decimal point in the number.</p> <p>2.460 00  </p> <p>Number of places = 5 to the right = +5</p> <p><i>Step 3:</i> Write the number using the number of places moved for the power of 10.</p> $246\,000 = 2.46 \times 10^5$	<p>Move the decimal point so that it is after the first non-zero digit. This produces a number between 1 and 10. Count the number of places (left or right) back to the original position of the decimal point in the number. This becomes the power of 10.</p>

**10** Write the following numbers in scientific notation.

**a** 372 000

**b** 54 000

**c** 2 980 000

**d** 3400

**e** 609 000

**f** 87 500

**g** 7 698 000

**h** 361 000 000

**i** 8000

**j** 56 000 000

### Example 9

Write 0.000 71 in scientific notation.

Solve	Think	Apply
$0.000\ 71 = 7.1 \times 10^{-4}$	<p><i>Step 1:</i> Move the decimal point so that it is positioned between the first and second digits of the number. In this case 7.1.</p> <p><i>Step 2:</i> Count the number of places back to the original position of the decimal point.</p> <p>00007.1            Number of places = 4 to the left = <math>-4</math></p> <p><i>Step 3:</i> Write the number using the number of places moved for the power of 10.</p>	<p>Move the decimal point so that it is after the first non-zero digit. This produces a number between 1 and 10. Count the number of places (left or right) back to the original position of the decimal point in the number. This becomes the power of 10.</p>

**11** Write the following numbers in scientific notation:

- a** 0.000 57      **b** 0.000 078      **c** 0.0061      **d** 0.000 002 96      **e** 0.000 801  
**f** 0.000 000 5      **g** 0.004 39      **h** 0.000 002 8      **i** 0.000 09      **j** 0.000 000 004 9

### Example 10

Write  $6.48 \times 10^6$  as an ordinary number.

Solve	Think	Apply
$6.48 \times 10^6 = 6\ 480\ 000$	<p>Reverse the process of Example 8. As the power of 10 is <math>+6</math>, move the decimal point 6 places to the right.</p> <p>6.480 000            Hence <math>6.48 \times 10^6 = 6\ 480\ 000</math>.</p>	<p>The power of 10 indicates how many places to move the decimal point (left or right).</p>

**12** Write the following numbers as ordinary numbers.

- a**  $7.32 \times 10^6$       **b**  $5.2 \times 10^4$       **c**  $5.67 \times 10^5$       **d**  $3.8 \times 10^3$       **e**  $9.27 \times 10^7$   
**f**  $6.914 \times 10^4$       **g**  $3.275 \times 10^6$       **h**  $7 \times 10^5$       **i**  $2 \times 10^8$       **j**  $3.08 \times 10^5$

Write  $3.51 \times 10^{-6}$  as an ordinary number.

Solve	Think	Apply
$3.51 \times 10^{-6} = 0.000\ 003\ 51$	<p>Reverse the process of Example 9. As the power of 10 is <math>-6</math>, move the decimal point 6 places to the left.</p> <p>0000003.51            Hence <math>3.51 \times 10^{-6} = 0.000\ 003\ 51</math>.</p>	<p>The power of 10 indicates how many places to move the decimal point (left or right).</p>

**13** Write the following as ordinary numbers.

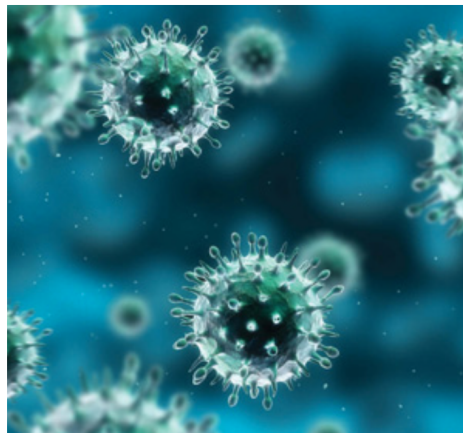
- a**  $3.98 \times 10^{-6}$     **b**  $5.3 \times 10^{-4}$     **c**  $7.09 \times 10^{-5}$     **d**  $8.8 \times 10^{-3}$     **e**  $5.9 \times 10^{-6}$   
**f**  $3.07 \times 10^{-7}$     **g**  $6 \times 10^{-4}$     **h**  $3 \times 10^{-6}$     **i**  $2.71 \times 10^{-5}$     **j**  $3.6 \times 10^{-10}$

**14** Express these numbers in scientific notation.

- a** The number of hairs on a person's head is approximately 129 000.  
**b** The distance from Earth to the Sun is 152 000 000 km.  
**c** The diameter of a hydrogen atom is 0.000 000 002 54 cm.  
**d** The size of the influenza virus is 0.000 000 26 m.  
**e** The average speed of Earth around the Sun is 107 000 km/h.

**15** Express the following as ordinary numbers.

- a** The distance of Mars from Earth is  $7.83 \times 10^7$  km.  
**b** The population of China is approximately  $1.4 \times 10^9$ .  
**c** A human brain cell is  $2.8 \times 10^{-5}$  m long.  
**d** A microsecond is equivalent to  $2.8 \times 10^{-10}$  h.  
**e** The number of cells in the human body is approximately  $10^{13}$ .



# Check your answers

- 1** **a** Yes      **b** No      **c** No      **d** Yes      **e** No  
**f** Yes      **g** No      **h** No      **i** No      **j** Yes

**2**

$10^0$	$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$
1	10	100	1000	10 000	100 000	1 000 000

- 3** **a**  $3 \times 10^6$       **b**  $7 \times 10^4$       **c**  $8 \times 10^3$   
**d**  $6 \times 10^5$       **e**  $5 \times 10^2$
- 4** **a**  $4.8 \times 10^3$       **b**  $3.92 \times 10^5$       **c**  $6.4 \times 10^4$   
**d**  $2.18 \times 10^6$       **e**  $7.6 \times 10^2$
- 5** **a** 30 000      **b** 7000      **c** 9 000 000  
**d** 400 000      **e** 800      **f** 460 000  
**g** 6710      **h** 3 900 000      **i** 83 600  
**j** 520 000

**6**

0.1	0.01	0.001	0.0001	0.000 01	0.000 001
$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10\ 000}$	$\frac{1}{100\ 000}$	$\frac{1}{1\ 000\ 000}$

- 7** **a**  $3 \times 10^{-3}$       **b**  $7 \times 10^{-6}$       **c**  $5 \times 10^{-4}$   
**d**  $2 \times 10^{-5}$       **e**  $9 \times 10^{-2}$
- 8** **a** 0.06      **b** 0.000 003      **c** 0.002  
**d** 0.0005      **e** 0.000 009
- 9** **a**  $3 \times 10^4 = 30\ 000$ ,  $3^4 = 81$   
**b**  $5 \times 10^{-2} = 0.05$ ,  $5^{-2} = \frac{1}{25}$   
**c**  $2 \times 10^3 = 2000$ ,  $2^3 = 8$   
**d**  $2 \times 10^{-5} = 0.000\ 02$ ,  $2^{-5} = \frac{1}{32} \approx 0.03$

**e**  $4 \times 10^6 = 4\,000\,000$ ,  $4^6 = 4096$

**f**  $5 \times 10^6 = 5\,000\,000$ ,  $5^6 = 15\,625$

**10 a**  $3.72 \times 10^5$       **b**  $5.4 \times 10^4$       **c**  $2.98 \times 10^6$

**d**  $3.4 \times 10^3$       **e**  $6.09 \times 10^5$       **f**  $8.75 \times 10^4$

**g**  $7.698 \times 10^6$       **h**  $3.61 \times 10^8$       **i**  $8 \times 10^3$

**j**  $5.6 \times 10^7$

**11 a**  $5.7 \times 10^{-4}$       **b**  $7.8 \times 10^{-5}$       **c**  $6.1 \times 10^{-3}$

**d**  $2.96 \times 10^{-6}$       **e**  $8.01 \times 10^{-4}$       **f**  $5 \times 10^{-7}$

**g**  $4.39 \times 10^{-3}$       **h**  $2.8 \times 10^{-6}$       **i**  $9 \times 10^{-5}$

**j**  $4.9 \times 10^{-9}$

**12 a** 7 320 000      **b** 52 000      **c** 567 000

**d** 3800      **e** 92 700 000      **f** 69 140

**g** 3 275 000      **h** 700 000      **i** 200 000 000

**j** 308 000

**13 a** 0.000 003 98      **b** 0.000 53      **c** 0.000 070 9

**d** 0.0088      **e** 0.000 005 9      **f** 0.000 000 307

**g** 0.0006      **h** 0.000 003      **i** 0.000 027 1

**j** 0.000 000 000 36

**14 a**  $1.29 \times 10^5$       **b**  $1.52 \times 10^8$  km

**c**  $2.54 \times 10^{-9}$  cm      **d**  $2.6 \times 10^{-7}$  m

**e**  $1.07 \times 10^5$  km/h

**15 a** 78 300 000 km      **b** 1 400 000 000

**c** 0.000 028 m      **d** 0.000 000 000 28 h

**e** 10 000 000 000 000