

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 6.7×10^8 **b** 23×10^5 **c** 3.65×1000 **d** 2.96×10^{-7} **e** 480 000

	Solve	Think	Apply
a	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	No	The first number (23) is not between 1 and 10.	
c	No	The second number (1000) is not expressed as a power of 10.	
d	Yes	The first number (2.96) is between 1 and 10 and it is multiplied by a power of 10 (10^{-7}).	
e	No	The number is not written as a product.	

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

- a** 5.9×10^6 **b** 34×10^8 **c** $8.97 \times 10\ 000$ **d** 5.03×10^{-9}
e 28 000 **f** 7×10^{-15} **g** 0.85×10^4 **h** 4.2×100
i 163 000 000 **j** 2.006×10^{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
a	$5\ 000\ 000 = 5 \times 1\ 000\ 000$ $= 5 \times 10^6$ 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	$40\ 000 = 4 \times 10\ 000$ $= 4 \times 10^4$	

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
a	$5300 = 5.3 \times 1000$ $= 5.3 \times 10^3$	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	$284\ 000 = 2.84 \times 100\ 000$ $= 2.84 \times 10^5$	

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 6×10^5

b 3.94×10^6

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

5 Write the following numbers as ordinary decimal numbers.

a 3×10^4

b 7×10^3

c 9×10^6

d 4×10^5

e 8×10^2

f 4.6×10^5

g 6.71×10^3

h 3.9×10^6

i 8.36×10^4

j 5.2×10^5

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
a	$0.004 = 4 \times 0.001$ $= 4 \times \frac{1}{1000}$ $= 4 \times \frac{1}{10^3}$ $= 4 \times 10^{-3}$	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	$0.000\ 009 = 9 \times 0.000\ 001$ $= 9 \times \frac{1}{1\ 000\ 000}$ $= 9 \times \frac{1}{10^6}$ $= 9 \times 10^{-6}$	

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 5×10^{-2}

b 7×10^{-6}

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

8 Write the following as ordinary decimal numbers.

a 6×10^{-2}

b 3×10^{-6}

c 2×10^{-3}

d 5×10^{-4}

e 9×10^{-6}

Example 7

Explain the difference between:

a 2×10^4 and 2^4

b 2×10^{-4} and 2^{-4}

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

9 Explain the difference between:

a 3×10^4 and 3^4

b 5×10^{-2} and 5^{-2}

c 2×10^3 and 2^3

d 2×10^{-5} and 2^{-5}

e 4×10^6 and 4^6

f 5×10^6 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 style="text-align: center;">2.460 00</p> <p style="text-align: center;">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.</p> <p>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 = -4</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 6.48×10^6 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 $+6$, move the decimal point 6 places to the right.</p> <p>6.480 000 Hence $6.48 \times 10^6 = 6\ 480\ 000$.</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** 7.32×10^6 **b** 5.2×10^4 **c** 5.67×10^5 **d** 3.8×10^3 **e** 9.27×10^7
f 6.914×10^4 **g** 3.275×10^6 **h** 7×10^5 **i** 2×10^8 **j** 3.08×10^5

Write 3.51×10^{-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 -6, move the decimal point 6 places to the left.</p> <p>0000003.51 Hence $3.51 \times 10^{-6} = 0.000\ 003\ 51$.</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.

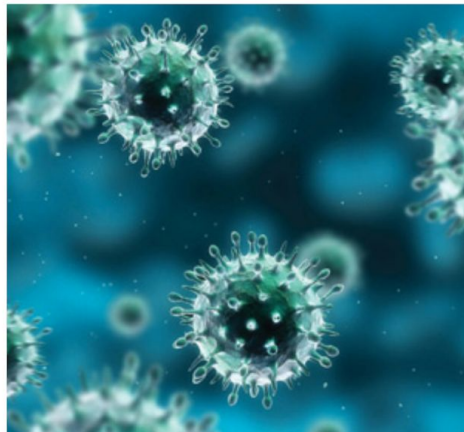
- a** 3.98×10^{-6} **b** 5.3×10^{-4} **c** 7.09×10^{-5} **d** 8.8×10^{-3} **e** 5.9×10^{-6}
f 3.07×10^{-7} **g** 6×10^{-4} **h** 3×10^{-6} **i** 2.71×10^{-5} **j** 3.6×10^{-10}

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 7.83×10^7 km.
b The population of China is approximately 1.4×10^9 .
c A human brain cell is 2.8×10^{-5} m long.
d A microsecond is equivalent to 2.8×10^{-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** 3×10^6 **b** 7×10^4 **c** 8×10^3
d 6×10^5 **e** 5×10^2
- 4** **a** 4.8×10^3 **b** 3.92×10^5 **c** 6.4×10^4
d 2.18×10^6 **e** 7.6×10^2
- 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** 3×10^{-3} **b** 7×10^{-6} **c** 5×10^{-4}
d 2×10^{-5} **e** 9×10^{-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 3.72×10^5 **b** 5.4×10^4 **c** 2.98×10^6

d 3.4×10^3 **e** 6.09×10^5 **f** 8.75×10^4

g 7.698×10^6 **h** 3.61×10^8 **i** 8×10^3

j 5.6×10^7

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

d 2.96×10^{-6} **e** 8.01×10^{-4} **f** 5×10^{-7}

g 4.39×10^{-3} **h** 2.8×10^{-6} **i** 9×10^{-5}

j 4.9×10^{-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 1.29×10^5 **b** 1.52×10^8 km

c 2.54×10^{-9} cm **d** 2.6×10^{-7} m

e 1.07×10^5 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