WALT understand and work with scientific notation
Success Criteria I know it's based on the power of 10

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
$246\,000 = 2.46 \times 10^5$	A quick method for writing in scientific notation is: *Step 1:* 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. *Step 2:* Count the number of places back to the original position of the decimal point in the number. 2.460 00 Number of places = 5 to the right = +5 *Step 3:* Write the number using the number of places moved for the power of 10. $246\,000 = 2.46 \times 10^5$	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.

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
$0.000\ 71 = 7.1 \times 10^{-4}$	*Step 1:* Move the decimal point so that it is positioned between the first and second digits of the number. In this case 7.1. *Step 2:* Count the number of places back to the original position of the decimal point. 0.0007.1 Number of places = 4 to the left = −4 *Step 3:* Write the number using the number of places moved for the power of 10.	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.

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

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
$3.51 \times 10^{-6} = 0.000\ 003\ 51$	Reverse the process of Example 9. As the power of 10 is −6, move the decimal point 6 places to the left. 0.000003.51 Hence $3.51 \times 10^{-6} = 0.000\ 003\ 51$.	The power of 10 indicates how many places to move the decimal point (left or right).

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.

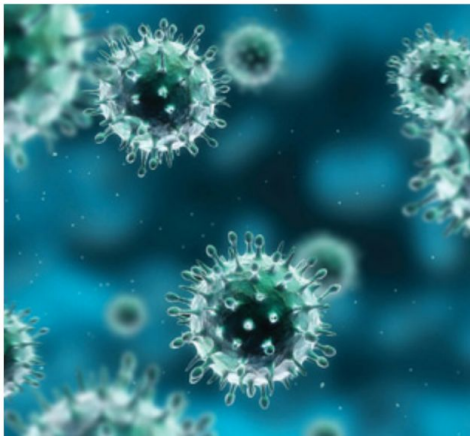
a The number of hairs on a person's head is approximately 129 000.

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