Learning Enhancement Team

University of East Anglia

STUDENT SUPPORT SERVICE

Model answers: Powers of 10 and Standard Form

Powers of 10 and Standard Form study guide

1. The power is the same as the number of zeroes.

(a) 10^5

The number of zeroes is 5 and so the power is 5. Also $10\times10\times10\times10\times10=100\,000$ which has 5 zeroes in it.

(b) 10^7

Here $1000\times10000=10\,000\,000$, which has 7 zeroes. You could also count the number of zeroes in each number which is 3 in 1000 and 4 in 10000 which gives a total of 7 zeroes.

(c) 10^9

Here $100\times10\,000\times1000=1\,000\,000\,000$, which has 9 zeroes. You could also count the number of zeroes in each number which is 2 in 100, 4 in 10000 and 3 in 1000 which gives a total of 9 zeroes.

(d) 10^{10}

Here $100\times10\,000\times1000\times10=10\,000\,000\,000$, which has 10 zeroes. This can be re-written as 10^{10}. You could also count the number of zeroes in each number which is 2 in 100, 4 in 10000, 3 in 1000 and 1 in 10 which gives a total of 10 zeroes.

2. Standard form is defined as $a \times 10^n$, where *a* is a decimal number between 1 and 10 and *n* is an integer (a positive of negative whole number or 0).

(a) 1×10^6

Here $1000 \times 1000 = 1\,000\,000$ which has 6 zeroes and so is equal to 10^6. However 10^6 is not in the form $a \times 10^n$. This is easily fixed by multiplying 10^6 by 1 to give 1×10^6 which is now in standard form and suitable to report as a scientific measurement.

(b) 6.8×10^5

First you put a decimal point after the first non-zero digit to get $a = 6.80000$. You should recognise that $6.80000 = 6.8$ and so it is better to write $a = 6.8$. Next you work out *n*. Your answer must be the same size as the original number and so $6.8 \times 10^n = 680\,000$. You must multiply 6.8 by 100 000 to get 68000 and, as $100\,000 = 10^5$, $n = 5$.

(c) 3.569×10^3.

First you put a decimal point after the first non-zero digit to get $a = 3.569$.

Next you work out *n*. Your answer must be the same size as the original number and so $3.569 \times 10^n = 3569$. You must multiply 3.569 by 1000 to get 3569 and, as $1000 = 10^3$, $n = 3$.

(d) 6.4×10^6

First you put a decimal point after the first non-zero digit to get $a = 6.400000$. You should recognise that $6.400000 = 6.4$ and so it is better to write $a = 6.4$. Next you work out *n*. Your answer must be the same size as the original number and so $6.4 \times 10^n = 6\,400\,000$. You must multiply 6.4 by 1 000 000 to get 640000 and, as $1000\,000 = 10^6$, $n = 6$.

(e) 6×10^{-3}

First you put the decimal point after the first non-zero digit to get $a = 6$.

Next you work out *n*. Your answer must be the same size as the original number and so $6 \times 10^n = 0.006$. You must divide 6 by 1000 to get 0.006 and, as $1/1000 = 10^{-3}$, $n = -3$.

(f) 1.13564×10^1

First you put the decimal point after the first non-zero digit to get $a = 1.13564$.

Next you work out *n*. Your answer must be the same size as the original number and so $1.13564 \times 10^n = 11.3564$. You must multiply 1.13564 by 10 to get 11.3564 and, as $10 = 10^1$, $n = 1$.

(g) 6.54×10^{-7}

First you put the decimal point after the first non-zero digit to get $a = 6.54$.

Next you work out *n*. Your answer must be the same size as the original number and so $6.54 \times 10^n = 0.000000654$. You must divide 6.54 by 10 000 000 to get 0.000000654 and, as $1/10000000 = 10^{-7}$, $n = -7$.

(h) 6.5735874×10^2

First you put the decimal point after the first non-zero digit to get $a = 6.5735874$.

Next you work out *n*. Your answer must be the same size as the original number and so $6.5735874 \times 10^n = 657.35874$. You must multiply 6.5735874 by 100 to get 657.35874 and, as $100 = 10^2$, $n = 2$.

3.

(a) To write 4.565×10^{13} as an ordinary number, you should recognise that $10^{13} = 10\,000\,000\,000\,000$ and so you need to calculate $4.565 \times 10\,000\,000\,000\,000$ which is $45\,650\,000\,000\,000$. This illustrates the advantage of standard form as the ordinary number is long and can be easily miswritten. The number is 45 trillion 650 billion.

(b) To write 7.651×10^5 as an ordinary number, you should recognise that $10^5 = 100\,000$ and so you need to calculate $7.651 \times 100\,000$ which is 765 100. The number is 756 thousand one hundred.

(c) 10^6 is written as 1 000 000 (one million).

(d) To write 6.954×10^7 as an ordinary number, you should recognise that $10^7 = 10\,000\,000$ and so you need to calculate $6.954 \times 10\,000\,000$ which is 69 540 000. The number is 69 million 540 thousand.

(e) To write 4.69×10^{-10} as an ordinary number, you should recognise that $10^{-10} = 1/10000000000$ and so you need to calculate $4.69 \div 10\,000\,000\,000$ which is 0.000000000469.

(f) To write 1.0654×10^{-3} as an ordinary number, you should recognise that $10^{-3} = 1/1000$ and so you need to calculate $1.0654 \div 1000$ which is 0.0010654.

4. $2.997924458 \times 10^8\ \text{ms}^{-1}$.

First you put a decimal point after the first non-zero digit to get $a = 2.997924458$.
Next you work out *n*. Your answer must be the same size as the original number and so $2.997924458 \times 10^n = 299792458$. You must multiply 2.997924458 by 10 000 000 to get 299792458 and, as $10\,000\,000 = 10^8$, $n = 8$.