

STANDARD FORM

Standard form is a way of writing very big numbers or very small numbers. A number in standard form must be written as a number between 1 and 10 multiplied by a power of 10. If the power is positive the number is greater than ten, but if the power is negative the number will be less than one.

Check that you:

- are familiar with powers of 10

$$10^1 = 10$$

$$10^{-1} = 0.1$$

$$10^2 = 100$$

$$10^{-2} = 0.01$$

$$10^3 = 1000$$

$$10^{-3} = 0.001$$

$$10^4 = 10\ 000$$

$$10^{-4} = 0.0001$$

$$10^5 = 100\ 000$$

$$10^{-5} = 0.00001$$

- understand how to x and ÷ by 10, 100, 1000 etc.

- remember rules of indices:

$$a^m \times a^n = a^{m+n} \text{ e.g. } 10^3 \times 10^5 = 10^{3+5} = 10^8$$

$$a^m \div a^n = a^{m-n} \text{ e.g. } 10^7 \div 10^4 = 10^{7-4} = 10^3$$

Writing ordinary numbers in standard form

Examples

Large Numbers

- 1) $50\ 000 = 5 \times 10\ 000 = 5 \times 10^4$
- 2) $2\ 300 = 2.3 \times 1000 = 2.3 \times 10^3$
- 3) $7\ 420\ 000 = 7.42 \times 1\ 000\ 000 = 7.42 \times 10^6$

Small Numbers

- 4) $0.0006 = 6 \times 0.0001 = 6 \times 10^{-4}$
- 5) $0.000048 = 4.8 \times 0.00001 = 4.8 \times 10^{-5}$
- 6) $0.00325 = 3.25 \times 0.001 = 3.25 \times 10^{-3}$

Writing numbers in standard form as ordinary numbers

Examples

Large Numbers

- 1) $4 \times 10^8 = 4 \times 100\ 000\ 000 = 400\ 000\ 000$
- 2) $3.8 \times 10^5 = 3.8 \times 100\ 000 = 380\ 000$
- 3) $1.77 \times 10^4 = 1.77 \times 10\ 000 = 17\ 700$

Small Numbers

- 4) $8 \times 10^{-5} = 8 \times 0.00001 = 0.00008$
- 5) $5.4 \times 10^{-3} = 5.4 \times 0.001 = 0.0054$
- 6) $2.06 \times 10^{-4} = 2.06 \times 0.0001 = 0.000206$

What do you notice?

The power tells us the number of places each digit is moved to return to its original position/value.

Multiplication

$$\begin{aligned} 1) (5 \times 10^4) \times (3 \times 10^2) &= 5 \times 3 \times 10^4 \times 10^2 \\ &= 15 \times 10^{4+2} \\ &= 15 \times 10^6 \\ &= 1.5 \times 10^7 \end{aligned}$$

$$\begin{aligned} 2) (6.4 \times 10^5) \times (2 \times 10^{-3}) &= 6.4 \times 2 \times 10^5 \times 10^{-3} \\ &= 12.8 \times 10^{5+(-3)} \\ &= 12.8 \times 10^2 \\ &= 1.28 \times 10^3 \end{aligned}$$

Division

$$\begin{aligned} 3) (2 \times 10^9) \div (8 \times 10^6) &= 2 \div 8 \times 10^9 \div 10^6 \\ &= 0.25 \times 10^{9-6} \\ &= 0.25 \times 10^3 \\ &= 2.5 \times 10^2 \end{aligned}$$

$$\begin{aligned} 4) (9 \times 10^{-4}) \div (3 \times 10^7) &= 9 \div 3 \times 10^{-4} \div 10^7 \\ &= 3 \times 10^{-4-7} \\ &= 3 \times 10^{-11} \end{aligned}$$

Addition

$$\begin{aligned} 5) (5 \times 10^4) + (6.2 \times 10^3) &= 50\ 000 + 6200 \\ &= 56\ 200 \\ &= 5.62 \times 10^4 \end{aligned}$$

$$\begin{aligned} 6) (3.2 \times 10^{-4}) + (5.4 \times 10^{-3}) &= 0.00032 + 0.0054 \\ &= 0.00572 \\ &= 5.72 \times 10^{-3} \end{aligned}$$

Subtraction

$$\begin{aligned} 7) (7.8 \times 10^4) - (5 \times 10^2) &= 78\ 000 - 500 \\ &= 77\ 500 \\ &= 7.75 \times 10^4 \end{aligned}$$

$$\begin{aligned} 8) (2.4 \times 10^{-2}) - (1.8 \times 10^{-3}) &= 0.024 - 0.0018 \\ &= 0.0222 \\ &= 2.22 \times 10^{-2} \end{aligned}$$

Remember to write your final answer to calculations in standard form i.e. a number between 1 and 10 multiplied by a power of 10.

Notice in examples 1 and 2, to write the answers in standard form, the number is ÷10 (made ten times smaller) therefore the power of ten must be increased by 1 (made ten times bigger). In example 3, the number is x10 (made ten times bigger) therefore the power of ten must be decreased by 1 (made ten times smaller).