STANDARD FORM

What do I need to be able to do?

You should be able to :

- Write numbers in standard form
- Convert numbers written in standard form to ordinary numbers
- Order numbers in standard form
- Add/subtract numbers in standard form
- Multiply/divide numbers in standard form
- Use a calculator when working with standard form

Key Words

Standard Form: a system of writing very big or small numbers
Commutative: changing the order of operations doesn't change the result
Base: the number that gets multiplied by a power
Power: the number of times the number is used in a multiplication
Index: power (see above)
Exponent: power (see above)
Negative: a value below zero

Converting ordinary numbers into standard form

$A \times 10^{n}$

A: Any number between 1 and 10
n: Any integer

Examples

700
$= 7 \times 10 \times 10$
$= 7 \times 10^{2}$

12500
$= 1.25 \times 10 \times 10 \times 10 \times 10$ (must be between 1 and 10)
$= 1.25 \times 10^{4}$

0.00034
$= 3.4 \times 10^{-4}$
Remember a negative power doesn't make the answer negative, just closer to 0!

Converting standard form into ordinary numbers

Example 1
2×10^{3}
$= 2 \times 10 \times 10 \times 10$
$= 2000$

Example 2
4.12×10^{2}
$= 4.12 \times 10 \times 10$
$= 412$

Non-Examples
$12 \times 10^{2} = 1200$ (must be between 1 and 10!)
$1.84 \times 10 = 14.62$ (must be an integer!)
$6.4 \times 8^{3} = 3276.8$ (must be a power of 10!)

Index Laws Recap

$10^{3} = 10 \times 10 \times 10 = 1000$ (+1)
$10^{2} = 10 \times 10 = 100$ (×10; Each time I add one to the power, I multiply by 10)
$10^{1} = 10$ (−1; ÷10; Each time I take one from the power, I divide by 10)
$10^{0} = 1$ (−1; ÷10; Therefore, 10 to the power of 0 is 1. Remember anything to the power 0 is 1)
$10^{-1} = \frac{1}{10}$ (÷10; If we carry this on, we can even say what 10 to the power of a negative number is!)

$10^{-2} = \frac{1}{100} = \frac{1}{10^{2}}$

$10^{-3} = \frac{1}{1000} = \frac{1}{10^{3}}$

We can even spot that 10 to the power of -2 is the same as 1 over 10 to the power of 2 (or 10 squared!)

Using a Calculator

If we need to write 1.3×10^{3} in our calculator;

You're going to need this button here!

Input 1.3 and then press 

Then press 3 for the power.

Your calculator will often give you the solution to your sum, if it is suitably big/small, in standard form.

Ordering Numbers in Standard Form

10^{4}	10^{3}	10^{2}	10^{1}	10^{0}	10^{-1}	10^{-2}	10^{-3}

3.1×10^{2} → 310
4.12×10^{4} → 41200
2×10^{-2} → 0.02
3.281×10^{3} → 3281
2.4×10^{-2} → 0.024

$2 \times 10^{-2} \rightarrow 2.4 \times 10^{-2} \rightarrow 3.1 \times 10^{2} \rightarrow 3.281 \times 10^{3} \rightarrow 4.12 \times 10^{4}$

Adding and Subtracting Numbers in Standard Form

$(2.1 \times 10^{6}) + (3.3 \times 10^{3})$

Foolproof method: convert both numbers to ordinary numbers and then add

$(2.1 \times 10^{6}) + (3.3 \times 10^{3})$
$2,100,000 + 3300$
$= 2,103,300$
$= 2.103 \times 10^{6}$

You should leave your answer in the form given in the question

$(7.32 \times 10^{-1}) - (2.8 \times 10^{-3})$
$0.732 - 0.0028$
$= 0.7292$
$= 7.292 \times 10^{-1}$

Remember, the best way to work out a subtraction is with column method!

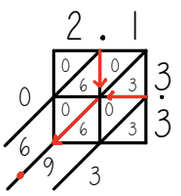
$$\begin{array}{r} 0.7320 \\ -\ 0.0028 \\ \hline 0.7292 \end{array}$$

Multiplying and Dividing Numbers in Standard Form

$(2.1 \times 10^{6}) \times (3.3 \times 10^{3})$

In multiplication and division problems, you can multiply the A values and the look at the powers of 10

$2.1 \times 3.3 \times 10^{6} \times 10^{3}$
$= 6.93 \times 10^{6} \times 10^{3}$ (Remember $a^{m} \times a^{n} = a^{m+n}$)
$= 6.93 \times 10^{9}$



$(2.8 \times 10^{8}) \div (7 \times 10^{5})$

$\frac{2.8 \times 10^{8}}{7 \times 10^{5}} = \frac{0.4 \times 10^{8}}{10^{5}} = 0.4 \times 10^{3}$ (Remember $a^{m} \div a^{n} = a^{m-n}$)

BUT...
0.4×10^{3} is not in standard form, as A is not a number between 1 and 10! So...
$0.4 \times 10^{3} = 400$
$= 4 \times 10^{2}$