WJEC MATHEMATICS

INTERMEDIATE

NUMBER

STANDARD FORM

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Contents

Credits

WJEC Question bank
http://www.wjec.co.uk/question-bank/question-search.html

Writing numbers in standard form

It is important you understand standard form. Standard form is a method of writing very large (and very small) numbers in a more efficient way.

Numbers in standard form are written in the following form

$$a \times 10^b$$

a must be a number between 1 and 10

b can be a positive or negative number (number of jumps)

Expressing a number in standard form

Consider the following large number:

$$53000000$$

To get this into standard form we need to find a number between 1 and 10. For this to be the case, we need the decimal point between the 5 and 3

$$5.3000000.$$

This is where we *want* the decimal point to be

This is where the decimal point currently is

We can see that to move from where it is to where we want it, the decimal point must jump 7 places to the left.

$$5.3 \times 10^7$$

If the jumps are to the LEFT (big number) the power is positive. If the jumps are to the RIGHT (small number) the power will be negative.

Consider the following small number:

$$0.00000231$$

To get this into standard form we need to find a number between 1 and 10. For this to be the case, we need the decimal point between the 2 and 3

$$0.000002.31$$

This is where the decimal point currently is

This is where we want the decimal point to be

We can see that to move from where it is to where we want it, the decimal point must jump 6 places to the right.

$$2.31\times10^{-6}$$

Exercise N20

Write the following large numbers in standard form

a. 40000
b. 1000000000
c. 54000000
d. 130000
e. 400
f. 751000000000
g. 19500
h. 22500000
i. 36950000000

Write the following small numbers in standard form

a. 0.00000012
b. 0.0023
c. 0.000004
d. 0.000000325
e. 0.00000000154
f. 0.0023
g. 0.0000315
h. 0.0001325
i. 0.00002115

Writing standard form numbers as ordinary numbers

When putting numbers into standard form, we counted how many times the decimal place jumped. When taking numbers out of standard forms we jump the decimal place the number in the power.

> Positive number = Jump to the right
> Negative number = Jump to the left

Here is a large number written in standard form

$$1.23\times10^{5}$$

Start with 1.23

Positive power means jump to the RIGHT - 5 places

$$123\overset{\cap\cap\cap\cap\cap}{}.$$

Under every 'empty arch' put a zero, and we get:

$$123000$$

Here is a small number written in standard form

$$4.3\times10^{-6}$$

Start with 4.3

Negative power means jump to the LEFT - 6 places

$$\overset{\cap\cap\cap\cap\cap}{}.\,4.3$$

Under every 'empty arch' put a zero, and a zero before the decimal point, and we get:

$$0.0000043$$

Exercise N21

Write the following large numbers as ordinary numbers

a. 3×10^{5}
b. 5×10^{7}
c. 7.7×10^{4}
d. 1.2×10^{2}
e. 2.9×10^{5}
f. 8.4×10^{8}
g. 3.51×10^{5}
h. 9.89×10^{7}
i. 1.27×10^{9}

Write the following small numbers as ordinary numbers

a. 5×10^{-4}
b. 5×10^{-9}
c. 7.7×10^{-4}
d. 1.2×10^{-3}
e. 2.9×10^{-5}
f. 8.4×10^{-7}
g. 3.51×10^{-6}
h. 9.89×10^{-8}
i. 1.72×10^{-10}

Adjusting numbers in standard form

Sometimes, you will have an answer to a question but it will not be in standard form. For example:

$$12.5\times10^{5}$$

It does look correct, but remember, the first number in standard form must be between 1 and 10. So it needs to be adjusted.

You can divide the front number by 10 then increase the power by 1
You can multiply the front number by 10 then decrease the power by 1

You may need to do this more than once

So for the example above:

$$12.5\times10^{5}$$

Divide this number by 10

Increase the power by 1

$$1.25\times10^{6}$$

Here's another example:

$$0.562\times10^{-6}$$

Multiply this number by 10 — Decrease this number by 1

$$5.62\times10^{-7}$$

Exercise N22

Adjust the following so they are in 'correct' standard form

a. 62.1×10^{-6}

b. 23.1×10^{5}

c. 45×10^{9}

d. 0.24×10^{9}

e. 0.56×10^{-5}

f. 0.13×10^{-4}

g. 123×10^{2}

h. 0.003×10^{-6}

i. 0.21×10^{-4}

Standard Form: Multiplication

Multiplication of two numbers in standard form looks like this:

$$(8.2\times10^{8})\times(2\times10^{-3})$$

When multiplying standard form:
MULTIPLY numbers and ADD powers

Not correct standard form so ADJUST! → 16.4×10^{5} ← Take care with signs. 8 + (-3)=5

$$1.64\times10^{6}$$

Exercise N23

Calculate the following without a calculator

a. $(2\times10^{3})\times(3\times10^{4})$

b. $(4\times10^{8})\times(2\times10^{5})$

c. $(1.2\times10^{4})\times(6\times10^{4})$

d. $(3\times10^{-9})\times(3\times10^{3})$

e. $(4\times10^{-7})\times(3\times10^{-2})$

f. $(6\times10^{10})\times(4\times10^{8})$

Standard Form: Division

Division of two numbers in standard form looks like this:

$$(3.9\times10^{3})\div(3\times10^{-4})$$

When dividing standard form:
DIVIDE numbers and SUBTRACT powers

1.3×10^{7} ← Take care with signs.
3 - (-4)=7

Exercise N24

Calculate the following without a calculator

a. $(8\times10^{5})\div(2\times10^{3})$

b. $(9\times10^{9})\div(3\times10^{9})$

c. $(5\times10^{9})\div(2\times10^{4})$

d. $(9\times10^{4})\div(4\times10^{8})$

e. $(1.2\times10^{6})\div(3\times10^{2})$

f. $(3.5\times10^{2})\div(5\times10^{9})$

Standard Form: Addition and Subtraction

When you're asked to add or subtract two numbers in standard form, the easiest calculation method is to write both as ordinary numbers and then use column method to add / subtract. Then put your answer back into standard form

See 'Four Operations and BIDMAS' for a recap on column method if needed.

Example

$$(2.4\times10^3) + (2.7\times10^4)$$

$$= 2400 + 27000$$

$$= 29400$$

$$= 2.94\times10^4$$

Exam Questions N12

1. *(a)* Express 0·000053 in standard form.

.....

[1]

2. *(b)* Evaluate $(4{\cdot}5 \times 10^7) \times (4 \times 10^5)$ giving your answer in standard form.

.....

.....

.....

.....

[2]

3. Evaluate each of the following giving all of your answers in **standard form**.

(a) $4{\cdot}5 \times 10^8 + 9{\cdot}4 \times 10^7$ [1]

.....

4. *(b)* $\frac{6\times10^{12}}{3\times10^{-6}}$ [1]

.....

5. *(a)* $(2{\cdot}5 \times 10^6) \times (8 \times 10^3)$ [2]

.....

.....

6. Find the value of $(9{\cdot}2 \times 10^5) - (3 \times 10^4)$. Give your answer in standard form. [2]

.....

7. Express 13 million in standard form. [1]

.....

.....

8. *(a)* Express 0·000053 in standard form.

.....

9. *(b)* Evaluate $(4{\cdot}5 \times 10^7) \times (4 \times 10^5)$ giving your answer in standard form. [1]

.....

10. Express each of the following numbers in standard form.

(a) 0·000056 [1]

.....

11. *(b)* 2300000000 [1]

.....

12. *(a)* Arrange the following numbers in ascending order.

2100 $2{\cdot}4 \times 10^{-3}$ $2{\cdot}4 \times 10^3$ 10^3

.....