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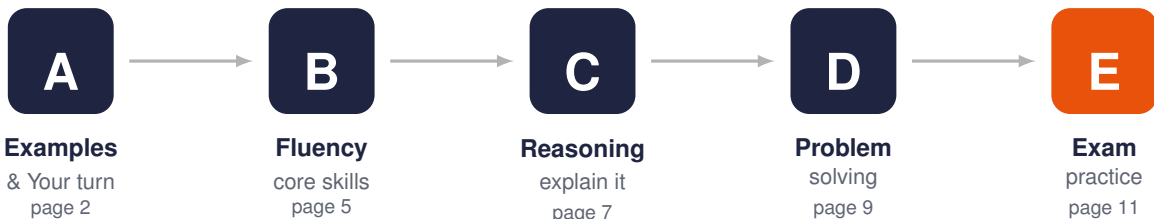
GCSE MATHEMATICS • NUMBER

Standard Form

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator only where shown

Free Standard Form worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: write large and small numbers in standard form and back again • order numbers in standard form • multiply and divide in standard form, with and without a calculator • *Higher:* add and subtract with different powers, take roots, compare sizes, and work with an unknown power of 10.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER The same skills where Higher papers use them: adding numbers with different powers, roots, comparing sizes, and standard form with an unknown power.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	25	11	14	12
Higher marks	12	14	16	16
My score				

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A

Worked examples & Your turn

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1: large numbers

- (a) Write 47 300 000 in standard form.
 (b) Write 6.2×10^4 as an ordinary number.

Standard form is $A \times 10^n$ where $1 \leq A < 10$. Count how many places the digits move.

- (a) 4.73 must be made 7 places bigger

Going back, 10^4 makes 6.2 four places bigger.

(a) 4.73×10^7 (b) 62 000

Your turn A1

- (a) Write 5 080 000 in standard form.
 (b) Write 3.9×10^5 as an ordinary number.

Worked example A2: small numbers

- (a) Write 0.000 52 in standard form.
 (b) Write 8.1×10^{-3} as an ordinary number.

A number less than 1 has a **negative** power of 10.

- (a) 5.2 must be made 4 places smaller

10^{-3} makes 8.1 three places smaller.

(a) 5.2×10^{-4} (b) 0.0081

Your turn A2

- (a) Write 0.0076 in standard form.
 (b) Write 2.4×10^{-5} as an ordinary number.

Worked example A3: multiplying

Work out $(4 \times 10^5) \times (6 \times 10^3)$

Give your answer in standard form.

Multiply the numbers. Add the powers.

$$4 \times 6 = 24 \quad 10^5 \times 10^3 = 10^8 \quad 24 \times 10^8$$

24 is not between 1 and 10. $24 = 2.4 \times 10^1$

$$2.4 \times 10^1 \times 10^8$$

2.4×10^9

Your turn A3

Work out $(5 \times 10^4) \times (7 \times 10^6)$

Give your answer in standard form.



Worked example A4: dividing

Work out $(2.4 \times 10^8) \div (6 \times 10^3)$

Give your answer in standard form.

Divide the numbers. Subtract the powers.

$$2.4 \div 6 = 0.4 \quad 10^8 \div 10^3 = 10^5 \quad 0.4 \times 10^5$$

0.4 is not between 1 and 10. $0.4 = 4 \times 10^{-1}$

$$4 \times 10^4$$

Your turn A4

Work out $(1.8 \times 10^7) \div (9 \times 10^2)$

Give your answer in standard form.

HIGHER

Higher strategies: these are new ways of thinking, not longer sums

Worked example A5: adding with different powers

Work out $(3.2 \times 10^5) + (4.5 \times 10^4)$

Give your answer in standard form.

You can only add when the powers of 10 match.

Rewrite the larger number using the smaller power.

$$3.2 \times 10^5 = 32 \times 10^4$$

Add, then put back into standard form.

$$32 \times 10^4 + 4.5 \times 10^4 = 36.5 \times 10^4$$

$$3.65 \times 10^5$$

Your turn A5

Work out $(6.1 \times 10^6) - (2.8 \times 10^5)$

Give your answer in standard form.

Worked example A6: how many times bigger?

A bee has a mass of 1.2×10^{-4} kg. A dog has a mass of 3.6×10^1 kg.

How many times heavier is the dog than the bee?

"How many times" means divide the larger by the smaller.

$$3.6 \div 1.2 = 3 \quad 10^1 \div 10^{-4} = 10^{1-(-4)} = 10^5$$

$$3 \times 10^5 \text{ times}$$

Your turn A6

A virus is 8×10^{-8} m long. A cell is 2.4×10^{-5} m long.

How many times longer is the cell than the virus?



Worked example A7: square roots in standard form

Work out $\sqrt{4.9 \times 10^9}$

Give your answer in standard form.

*The power must be **even** so it can be halved. Rewrite 4.9×10^9 as 49×10^8*

Square root each part.

$$\sqrt{49} = 7 \quad \sqrt{10^8} = 10^4$$

7×10^4

Your turn A7

Work out $\sqrt{3.6 \times 10^7}$

Give your answer in standard form.

Worked example A8: an unknown power of 10

$x = 4 \times 10^n$ where n is an integer.

Write x^2 in standard form.

Square the number and square the power of 10.

$$x^2 = 16 \times 10^{2n}$$

16 is not between 1 and 10. $16 = 1.6 \times 10^1$, so add 1 to the power.

$1.6 \times 10^{2n+1}$

Your turn A8

$y = 3 \times 10^n$ where n is an integer.

Write $40y$ in standard form.



B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer? No calculator except B6.

FOUNDATION*Everyone starts here***B1** Write in standard form.

(a) 3000

(b) 3400

(c) 3 400 000

(d) 34

[4 marks]**B2** Write in standard form.

(a) 0.3

(b) 0.034

(c) 0.000 34

(d) 0.000 030 4

[4 marks]**B3** Write as an ordinary number.

(a) 5×10^4

(b) 5.2×10^4

(c) 5.02×10^{-3}

(d) 5×10^0

[4 marks]**B4** These numbers are **not** in standard form. Write each one in standard form.

(a) 45×10^3

(b) 0.6×10^5

(c) 230×10^{-4}

(d) 0.08×10^{-2}

[4 marks]**B5** Work out. Give each answer in standard form.

(a) $(2 \times 10^3) \times (4 \times 10^5)$

(b) $(3 \times 10^{-2}) \times (2 \times 10^6)$

(c) $(8 \times 10^7) \div (2 \times 10^3)$

(d) $(9 \times 10^2) \div (3 \times 10^{-4})$

[4 marks]**B6** (*calculator*) Work out. Give each answer in standard form.

(a) $(3.7 \times 10^5) \times (2.9 \times 10^4)$

(b) $(8.64 \times 10^{-3}) \div (2.4 \times 10^5)$

(c) $(4.1 \times 10^6)^2$

[3 marks]**B7** Write these numbers in order of size. Start with the smallest.

6.1×10^4

5.8×10^5

61 500

6×10^{-4}

[2 marks]

HIGHER*Higher tier only***B8** Work out. Give each answer in standard form.

(a) $(6 \times 10^4) \times (5 \times 10^3)$

(b) $(8 \times 10^{-3}) \times (7 \times 10^{-2})$

(c) $(2 \times 10^5) \div (8 \times 10^2)$

(d) $(3 \times 10^{-4}) \div (6 \times 10^3)$

[4 marks]**B9** Work out. Give each answer in standard form.

(a) $(5 \times 10^4) + (3 \times 10^4)$

(b) $(7 \times 10^5) + (6 \times 10^5)$

(c) $(4.2 \times 10^6) + (3 \times 10^4)$

(d) $(5 \times 10^{-3}) - (4 \times 10^{-4})$

[4 marks]**B10** Work out. Give each answer in standard form.

(a) $(3 \times 10^4)^2$

(b) $(5 \times 10^3)^2$

(c) $\sqrt{1.6 \times 10^9}$

(d) $(2 \times 10^{-3})^3$

[4 marks]

C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

C1 Which of these numbers are written in standard form? Give a reason for each one that is not.

$$12 \times 10^4 \quad 3.5 \times 10^{-2} \quad 0.7 \times 10^3 \quad 9.99 \times 10^0$$

[2 marks]

C2 Mo writes $0.0045 = 4.5 \times 10^3$

Explain Mo's mistake, and write down the correct answer.

[2 marks]

C3 Which is larger, 8.9×10^5 or 1.2×10^6 ?

You **must** give a reason.

[2 marks]

C4 Eli's calculator display shows $3.6\text{E}-5$

Write this number **(a)** in standard form **(b)** as an ordinary number.

[2 marks]

C5 Write each of these in standard form.

(a) two hundred and six thousand **(b)** 72 million **(c)** three millionths

[3 marks]



HIGHER*Higher tier only*

C6 Ana writes $(4 \times 10^3) + (3 \times 10^2) = 7 \times 10^5$

Explain Ana's mistake, and work out the correct answer in standard form.

[2 marks]

C7 Raj says, "When you multiply $a \times 10^m$ by $b \times 10^n$, both in standard form, the answer in standard form always has the power $m + n$."

Give an example to show that Raj is wrong.

[2 marks]

C8 $x = 3 \times 10^m$ and $y = 5 \times 10^n$ where m and n are integers.

Write xy in standard form.

[3 marks]

C9 $p = 2 \times 10^n$ where n is an integer. Write each of these in standard form.

(a) p^3

(b) $\frac{1}{p}$

[4 marks]

C10 $2^{10} = 1024$

Use this to decide, without a calculator, which is larger: 2^{40} or 10^{12}

You must show your reasoning.

[3 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

D1 The table shows the distance of four planets from the Sun.

Planet	Distance from the Sun (km)
Mercury	5.79×10^7
Earth	1.5×10^8
Mars	2.28×10^8
Jupiter	7.78×10^8

(a) Which planet is closest to the Sun?

(b) How much further from the Sun is Mars than Earth? Give your answer in standard form. [3 marks]

D2 A pile of 500 sheets of paper is 5 cm high.

Work out the thickness of one sheet in metres. Give your answer in standard form. [3 marks]

D3 (calculator) Light travels at 3×10^8 metres per second.

How far does light travel in one hour? Give your answer in standard form. [3 marks]

D4 A website had 2.4×10^6 visits in 30 days.

Work out the mean number of visits per day. Give your answer in standard form. [2 marks]

D5 One grain of sand has a mass of 6×10^{-5} kg.

How many grains of sand are there in 3 kg of sand? Give your answer in standard form. [3 marks]



HIGHER*Higher tier only*

- D6** A country has a population of 6.4×10^7 and an area of $2.5 \times 10^5 \text{ km}^2$.
Work out the number of people per km^2 . Give your answer as an ordinary number. [3 marks]
- D7** $E = mc^2$
Work out the value of E when $m = 2.5 \times 10^{-3}$ and $c = 3 \times 10^8$
Give your answer in standard form. [3 marks]
- D8** (*calculator*) The mass of the Sun is $2 \times 10^{30} \text{ kg}$. The mass of the Earth is $6 \times 10^{24} \text{ kg}$.
The mass of the Sun is k times the mass of the Earth. Work out k . Give your answer in standard form correct to 2 significant figures. [3 marks]
- D9** Three companies make profits of $\text{£}4.7 \times 10^6$, $\text{£}8.5 \times 10^5$ and $\text{£}1.2 \times 10^7$
Work out the total profit. Give your answer in standard form. [3 marks]
- D10** $x = 6 \times 10^n$ and $y = 5 \times 10^{n-1}$ where n is an integer.
(a) Write $x + y$ in standard form. (b) Write $\frac{x}{y}$ in standard form. [4 marks]



**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover*

E1 (a) Write 3.06×10^5 as an ordinary number.

.....
(1)

(b) Write 0.000 91 in standard form.

.....
(1)

(c) Write 45 million in standard form.

.....
(1)

(Total for Question E1 is 3 marks)

E2 (a) Work out $(3 \times 10^4) \times (2 \times 10^5)$
Give your answer in standard form.

.....
(2)

(b) Work out $(8.4 \times 10^9) \div (2 \times 10^3)$
Give your answer in standard form.

.....
(2)

(Total for Question E2 is 4 marks)



E3 Write these numbers in order of size. Start with the smallest number.

3.2×10^{-2}

0.03

3.4×10^{-3}

0.003

.....
(Total for Question E3 is 2 marks)

E4 (calculator) Work out $\frac{2.8 \times 10^7 + 4.5 \times 10^6}{1.3 \times 10^{-2}}$

Give your answer in standard form.

.....
(Total for Question E4 is 3 marks)

HIGHER

Higher tier only

E5 Work out $(7 \times 10^5) \times (8 \times 10^{-2})$

Give your answer in standard form.

.....
(Total for Question E5 is 2 marks)



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- E6** Work out $(2.7 \times 10^4) \div (9 \times 10^{-3})$
Give your answer in standard form.

.....

(Total for Question E6 is 2 marks)

- E7** Work out $(6.4 \times 10^5) - (3.9 \times 10^4)$
Give your answer in standard form.

.....

(Total for Question E7 is 3 marks)

- E8** A spacecraft travels 4.5×10^8 km at an average speed of 2.5×10^4 km/h.
(a) Work out the time taken in hours. Give your answer in standard form.

..... hours

(2)

- (b)** Work out the time taken in days.

..... days

(2)

(Total for Question E8 is 4 marks)



E9 $x = 2.5 \times 10^m$ and $y = 4 \times 10^n$ where m and n are integers.

$$xy = 10^7 \quad \text{and} \quad \frac{x}{y} = 6.25 \times 10^3$$

Find the value of m and the value of n .

$$m = \dots\dots\dots n = \dots\dots\dots$$

(Total for Question E9 is 5 marks)

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