

# Standard Form

## Solutions

For AQA GCSE Mathematics (8300) • Foundation tier

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Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

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**1** (4 marks)

- (a) Write 480 000 in standard form.

Standard form is (a number from 1 up to 10)  $\times$  (a power of 10).

Put the decimal point after the first digit: 4.8

4.8 must be multiplied by 100 000 to get 480 000.

$$100\,000 = 10^5$$

**Answer:**  $4.8 \times 10^5$

**Tip:**  $48 \times 10^4$  is equal to 480 000, but it is not in standard form, because 48 is bigger than 10.

- (b) Write 0.000 64 in standard form.

Put the decimal point after the first non-zero digit: 6.4

$$0.000\,64 = 6.4 \div 10\,000$$

Dividing by 10 000 is the same as  $\times 10^{-4}$ .

**Answer:**  $6.4 \times 10^{-4}$

**Tip:** Small numbers (less than 1) have a **negative** power of 10.

- (c) Write  $4.08 \times 10^3$  as an ordinary number.

$$10^3 = 1000$$

$$4.08 \times 1000 = 4080$$

(Move the digits 3 places to the left.)

**Answer:** 4080

(d) Write  $6 \times 10^{-2}$  as an ordinary number.

$\times 10^{-2}$  means divide by 100.

$$6 \div 100 = 0.06$$

**Answer:** 0.06

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**2** (1 mark)

Circle the number written in standard form.

Options:  $36 \times 10^5$ ,  $0.7 \times 10^{-2}$ ,  $3 \times 1000$ ,  $8.4 \times 10^6$

In standard form, the first number must be at least 1 and less than 10.

It must be multiplied by a power of 10.

36 is too big and 0.7 is too small.

1000 is not written as a power of 10.

$8.4 \times 10^6$  fits both rules.

**Answer:**  $8.4 \times 10^6$

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**3** (1 mark)

Zara says,

‘25 000 in standard form is  $25 \times 10^3$ ’

Is she correct? Tick a box.

Give a reason for your answer.

$25 \times 10^3$  does equal 25 000.

But it is not in standard form, because 25 is not between 1 and 10.

In standard form it is  $2.5 \times 10^4$ .

**Answer:** No, it should be  $2.5 \times 10^4$

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**4** (2 marks)

Write the number four million thirty thousand six hundred in standard form.

First write it in figures:

four million = 4 000 000

thirty thousand = 30 000

six hundred = 600

Total: 4 030 600

Put the decimal point after the first digit: 4.0306

The 4 is in the millions column, so multiply by  $10^6$ .

**Answer:**  $4.0306 \times 10^6$

**Tip:** Most errors here come from writing the number in figures with the wrong number of zeros. Use place-value columns to help.

*Marks:* 1 mark for 4 030 600. 1 mark for  $4.0306 \times 10^6$ .

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**5** (2 marks)

Work out  $(3 \times 10^4) \times (2 \times 10^5)$

Give your answer in standard form.

Multiply the numbers:  $3 \times 2 = 6$

Multiply the powers of 10 by adding the powers:

$$10^4 \times 10^5 = 10^{4+5} = 10^9$$

**Answer:**  $6 \times 10^9$

*Marks:* 1 mark for 6 or  $10^9$ . 1 mark for  $6 \times 10^9$ .

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**6** (2 marks)

Work out  $(8 \times 10^6) \div (4 \times 10^2)$

Give your answer in standard form.

Divide the numbers:  $8 \div 4 = 2$

Divide the powers of 10 by subtracting the powers:

$$10^6 \div 10^2 = 10^{6-2} = 10^4$$

**Answer:**  $2 \times 10^4$

*Marks:* 1 mark for 2 or  $10^4$ . 1 mark for  $2 \times 10^4$ .

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**7** (2 marks)

Work out  $(5 \times 10^3) \times (7 \times 10^4)$

Give your answer in standard form.

Multiply the numbers:  $5 \times 7 = 35$

Add the powers:  $10^3 \times 10^4 = 10^7$

So the answer is  $35 \times 10^7$ .

But 35 is not between 1 and 10.

$$35 = 3.5 \times 10, \text{ so } 35 \times 10^7 = 3.5 \times 10^8$$

**Answer:**  $3.5 \times 10^8$

**Tip:**  $35 \times 10^7$  is not in standard form. When the front number is 10 or more, divide it by 10 and add 1 to the power.

*Marks:* 1 mark for  $35 \times 10^7$  (or 350 000 000). 1 mark for  $3.5 \times 10^8$ .

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**8** (2 marks)

Work out  $3000 \times 50\,000$

Give your answer in standard form.

Write each number in standard form:

$$3000 = 3 \times 10^3 \text{ and } 50\,000 = 5 \times 10^4$$

$$3 \times 5 = 15 \text{ and } 10^3 \times 10^4 = 10^7$$

$$15 \times 10^7 = 1.5 \times 10^8$$

(Check:  $3000 \times 50\,000 = 150\,000\,000$ )

**Answer:**  $1.5 \times 10^8$

*Marks:* 1 mark for 150 000 000 or  $15 \times 10^7$ . 1 mark for  $1.5 \times 10^8$ .

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**9** (2 marks)

Work out  $60\,000\,000 \div 300$

Give your answer in standard form.

Cancel two zeros from each number:

$$60\,000\,000 \div 300 = 600\,000 \div 3$$

$$600\,000 \div 3 = 200\,000$$

$$200\,000 = 2 \times 10^5$$

**Answer:**  $2 \times 10^5$

**Tip:** Read the question again: it asks for standard form. Leaving the answer as 200 000 loses a mark.

*Marks:* 1 mark for 200 000. 1 mark for  $2 \times 10^5$ .

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**10** (2 marks)

Put these numbers in order, starting with the smallest.

$$4.2 \times 10^3 \quad 3.9 \times 10^4 \quad 5.1 \times 10^{-1} \quad 42\,000$$

Write each one as an ordinary number:

$$4.2 \times 10^3 = 4200$$

$$3.9 \times 10^4 = 39\,000$$

$$5.1 \times 10^{-1} = 0.51$$

42 000

Smallest to largest: 0.51, 4200, 39 000, 42 000

**Answer:**  $5.1 \times 10^{-1}$ ,  $4.2 \times 10^3$ ,  $3.9 \times 10^4$ , 42 000

*Marks:* 1 mark for changing them to the same form. 1 mark for the correct order.

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**11** (2 marks)

You may use a calculator.

Work out  $\frac{7.44 \times 10^{12}}{2.4 \times 10^5}$

Give your answer in standard form.

Divide the numbers:  $7.44 \div 2.4 = 3.1$

Subtract the powers:  $10^{12} \div 10^5 = 10^7$

3.1 is between 1 and 10, so the answer is in standard form.

**Answer:**  $3.1 \times 10^7$

*Marks:* 1 mark for 31 000 000 or  $3.1 \times 10^n$ . 1 mark for  $3.1 \times 10^7$ .

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**12** (2 marks)

The mass of an electron is  $9.1 \times 10^{-31}$  kg.

The mass of a proton is  $1.67 \times 10^{-27}$  kg.

You may use a calculator.

How many times heavier is a proton than an electron?

Give your answer to 3 significant figures.

“How many times heavier” means divide the bigger mass by the smaller mass.

$$(1.67 \times 10^{-27}) \div (9.1 \times 10^{-31}) = 1835.1\dots$$

To 3 significant figures: 1840

**Answer:** 1840

**Tip:** Use the  $\times 10^x$  button on your calculator, or put brackets around each number. Otherwise the calculator may divide by only part of the number.

*Marks:* 1 mark for dividing the proton mass by the electron mass. 1 mark for 1840.

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