

Standard Form

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

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.

1 (4 marks)

- (a) Write 572 000 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: 5.72

$$5.72 \times 100\,000 = 572\,000$$

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

Answer: 5.72×10^5

- (b) Write 0.00847 in standard form.

Put the decimal point after the first non-zero digit: 8.47

$$0.00847 = 8.47 \div 1000$$

Dividing by 1000 is the same as $\times 10^{-3}$.

Answer: 8.47×10^{-3}

- (c) Write 7.3×10^{-4} as an ordinary number.

$\times 10^{-4}$ means divide by 10 000.

Move the digits 4 places to the right: $7.3 \rightarrow 0.00073$

Answer: 0.00073

Tip: A negative power makes the number **smaller**, so the answer starts with 0.000.
73 000 is wrong.

(d) Write 2.06×10^5 as an ordinary number.

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

$$2.06 \times 100\,000 = 206\,000$$

Answer: 206 000

2 (1 mark)

Explain why 0.46×10^{-2} is not in standard form.

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

0.46 is less than 1.

(In standard form it is 4.6×10^{-3} .)

Answer: 0.46 is less than 1 (should be 4.6×10^{-3})

3 (2 marks)

Write these numbers in order of size.

Start with the smallest number.

$$0.0035 \quad 3.5 \times 10^{-4} \quad 3.5 \times 10^{-2} \quad 0.00035 \times 10^3$$

Write each one as an ordinary number:

$$0.0035$$

$$3.5 \times 10^{-4} = 0.00035$$

$$3.5 \times 10^{-2} = 0.035$$

$$0.00035 \times 10^3 = 0.35$$

Smallest to largest: 0.00035, 0.0035, 0.035, 0.35

Answer: 3.5×10^{-4} , 0.0035, 3.5×10^{-2} , 0.00035×10^3

Tip: With negative powers, 10^{-4} is smaller than 10^{-2} . Changing everything to ordinary numbers is the safest way to compare.

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

4 (2 marks)

Work out $(4.5 \times 10^7) \times (2 \times 10^{-3})$

Give your answer in standard form.

Multiply the numbers: $4.5 \times 2 = 9$

Add the powers: $10^7 \times 10^{-3} = 10^{7+(-3)} = 10^4$

Answer: 9×10^4

Tip: When you multiply powers of 10, add the powers. Do not multiply them: $10^7 \times 10^{-3}$ is not 10^{-21} .

Marks: 1 mark for 9 or 10^4 . 1 mark for 9×10^4 .

5 (2 marks)

Work out $\frac{6.3 \times 10^8}{9 \times 10^2}$

Give your answer in standard form.

Divide the numbers: $6.3 \div 9 = 0.7$

Subtract the powers: $10^8 \div 10^2 = 10^6$

So the answer is 0.7×10^6 .

But 0.7 is less than 1.

$$0.7 = 7 \times 10^{-1}, \text{ so } 0.7 \times 10^6 = 7 \times 10^5$$

Answer: 7×10^5

Tip: 0.7×10^6 is not in standard form. If the front number is less than 1, multiply it by 10 and take 1 off the power.

Marks: 1 mark for 0.7×10^6 (or 700 000). 1 mark for 7×10^5 .

6 (2 marks)

Work out $(2.4 \times 10^5) + (3.8 \times 10^4)$
Give your answer in standard form.

To add, first change to ordinary numbers:

$$2.4 \times 10^5 = 240\,000$$

$$3.8 \times 10^4 = 38\,000$$

$$240\,000 + 38\,000 = 278\,000$$

$$278\,000 = 2.78 \times 10^5$$

Answer: 2.78×10^5

Tip: You cannot just add $2.4 + 3.8$, because the powers of 10 are different.

Marks: 1 mark for 278 000 (or 240 000 and 38 000). 1 mark for 2.78×10^5 .

7 (2 marks)

Work out $\frac{0.05 \times 0.0006}{0.02}$

Give your answer in standard form.

Top: 0.05×0.0006

$5 \times 6 = 30$, and there are $2 + 4 = 6$ decimal places.

So $0.05 \times 0.0006 = 0.000030 = 0.00003$

Divide by 0.02: multiply top and bottom by 100.

$$0.00003 \div 0.02 = 0.003 \div 2 = 0.0015$$

$$0.0015 = 1.5 \times 10^{-3}$$

Answer: 1.5×10^{-3}

Marks: 1 mark for 0.00003 or 0.0015 (or 3×10^{-5}). 1 mark for 1.5×10^{-3} .

8 (2 marks)

A computer takes 2.5×10^{-9} seconds to carry out one calculation.
Work out the number of calculations the computer can carry out in 0.04 seconds.
Give your answer in standard form.

Number of calculations = total time $\div$ time for one calculation

$$0.04 = 4 \times 10^{-2}$$

$$\frac{4 \times 10^{-2}}{2.5 \times 10^{-9}}$$

Divide the numbers: $4 \div 2.5 = 1.6$

Subtract the powers: $-2 - (-9) = 7$, so 10^7

$$\text{Number of calculations} = 1.6 \times 10^7$$

Answer: 1.6×10^7

Tip: Divide the total time by the time for one calculation, not the other way round. Take care with the negative powers: $-2 - (-9) = +7$.

Marks: 1 mark for $0.04 \div (2.5 \times 10^{-9})$. 1 mark for 1.6×10^7 .

9 (2 marks)

You may use a calculator.

A light year is 9.46×10^{12} km.

A star is 4.2 light years away.

Work out the distance to the star in km.

Give your answer in standard form correct to 3 significant figures.

$$\text{Distance} = 4.2 \times 9.46 \times 10^{12}$$

$$4.2 \times 9.46 = 39.732$$

$$\text{So distance} = 39.732 \times 10^{12}$$

$$\text{In standard form: } 3.9732 \times 10^{13}$$

$$\text{To 3 significant figures: } 3.97 \times 10^{13}$$

Answer: 3.97×10^{13} km

Marks: 1 mark for $4.2 \times 9.46 \times 10^{12}$ (or 3.9732×10^{13}). 1 mark for 3.97×10^{13} .

10 (2 marks)

You may use a calculator.

$$\text{Work out } \frac{4.8 \times 10^5 \times 3.5 \times 10^{-2}}{2.8 \times 10^{-3}}$$

Give your answer in standard form.

$$\text{Top: } 4.8 \times 3.5 = 16.8 \text{ and } 10^5 \times 10^{-2} = 10^3$$

$$\text{So the top is } 16.8 \times 10^3 = 16\,800.$$

$$\text{Bottom: } 2.8 \times 10^{-3} = 0.0028$$

$$16\,800 \div 0.0028 = 6\,000\,000$$

$$6\,000\,000 = 6 \times 10^6$$

Answer: 6×10^6

Tip: On a calculator, use the $\times 10^x$ button and put brackets around the whole bottom (or use the fraction button).

Marks: 1 mark for 16 800 or 1.68×10^4 . 1 mark for 6×10^6 .

11 (3 marks)

You may use a calculator.

The population of the UK is about 6.8×10^7

The population of Wales is about 3.1×10^6

What percentage of the UK population lives in Wales?

Give your answer to 1 decimal place.

$$\text{Percentage} = \frac{\text{Wales}}{\text{UK}} \times 100$$

$$(3.1 \times 10^6) \div (6.8 \times 10^7) = 0.04558 \dots$$

$$0.04558 \dots \times 100 = 4.558 \dots$$

To 1 decimal place: 4.6%

Answer: 4.6%

Marks: 1 mark for $\frac{3.1 \times 10^6}{6.8 \times 10^7}$. 1 mark for multiplying by 100. 1 mark for 4.6%.
