Standard Form

Quick revision notes

Open it online

Name: _____

Date: _____

At a glance

Writing very large and very small numbers as A × 10^n, ordering them, and calculating with them.

1. What standard form is
2. Ordering numbers in standard form
3. Calculating without a calculator
4. Using a calculator and real problems

1. What standard form is

I revised this

- A number in standard form is **A × 10^n** with 1 ⩽ A < 10 and n a whole number.
- Large numbers have a positive power: 4 560 000 = 4.56 × 10^6.
- Numbers less than 1 have a negative power: 0.00072 = 7.2 × 10^{-4}.
- The power is how many places the decimal point moves to get A.

How to do it

1. Write the digits with the point after the first non-zero digit (that is A).
2. Count the places the point moved.
3. Moved left (big number) → positive power; moved right (small number) → negative power.

Ordinary	Standard form
300 000	3 × 10^5
45 600	4.56 × 10^4
0.05	5 × 10^{-2}
0.000 307	3.07 × 10^{-4}

Worked example

Write 0.000 307 in standard form.

1. First non-zero digit is 3: A = 3.07.
2. The point moves 4 places to the right.

3.07 × 10^{-4}

2. Ordering numbers in standard form

I revised this

- Compare the powers first: the bigger power is the bigger number (for positive numbers).
- If the powers are equal, compare the A values.
- Negative powers: 10^{-2} is bigger than 10^{-3}.

Worked example

Order, smallest first: 3.1 × 10^{-2}, 9.8 × 10^{-3}, 1.2 × 10^{-2}.

1. 10^{-3} is the smallest power, so 9.8 × 10^{-3} is smallest.
2. Then 1.2 × 10^{-2} before 3.1 × 10^{-2}.

9.8 × 10^{-3}, 1.2 × 10^{-2}, 3.1 × 10^{-2}

3. Calculating without a calculator

☐ I revised this

- Multiply: multiply the A values and **add** the powers.
- Divide: divide the A values and **subtract** the powers.
- Then fix the answer if A is not between 1 and 10: $12 \times 10^9 = 1.2 \times 10^{10}$; $0.5 \times 10^3 = 5 \times 10^2$.
- Add or subtract: change both numbers to ordinary numbers (or to the same power), then add.

Formulas

$(a \times 10^m)(b \times 10^n) = ab \times 10^{m+n}$
$(a \times 10^m) \div (b \times 10^n) = (a/b) \times 10^{m-n}$

Worked example

Work out $(6 \times 10^5) \div (1.5 \times 10^{-2})$.

1. $6 \div 1.5 = 4$.
2. $10^{5-(-2)} = 10^7$.

4×10^7

Exam tip: Adding: $5 \times 10^3 + 7 \times 10^2 = 5000 + 700 = 5700 = 5.7 \times 10^3$.

4. Using a calculator and real problems

☐ I revised this

- Use the **$\times 10^x$** (EXP) key: type 3.2 $\times 10^x$ 5, not 3.2 × 10 ^ 5 (which can go wrong with division).
- Give the final answer in standard form if the question uses it, rounded to 3 significant figures.
- Typical contexts: distances in space, masses of atoms, populations, speed of light (3×10^8 m/s).

Worked example

Light travels 3×10^8 m each second. How long does it take to travel 1.5×10^{11} m?

1. time = distance ÷ speed.
2. $1.5 \div 3 = 0.5$ and $10^{11-8} = 10^3$.
3. $0.5 \times 10^3 = 500$.

500 seconds

Common mistakes

Don't write	Write instead
✗ Leaving 45.6×10^5 as the answer	✓ A must be between 1 and 10: 4.56×10^6
✗ $0.00072 = 7.2 \times 10^4$	✓ Small numbers need a negative power: 7.2×10^{-4}
✗ Adding the powers when adding numbers	✓ Only multiplication adds the powers
✗ Calculator answer 2.4E7 copied as 2.4^7	✓ It means 2.4×10^7

In the exam

- Read whether the answer must be in standard form — then give it in standard form.
- On the non-calculator paper, show the separate steps for the numbers and the powers.
- Check size: a speed or distance should be sensible after you divide.

My notes