Scientific Notation and Significant Figures

Grade 10 – 11 science · notation

Name: Date: Score: / 26

Why scientists write numbers this way

Scientific notation puts a number as $\mathbf{m \times 10^{n}}$, with the mantissa m between 1 and 10. It is usually introduced as a way to avoid writing long strings of zeros, which is true but is not the main reason it exists.

The real reason is precision. Written plainly, 1200 could carry two, three or four significant figures and nothing in the notation says which. Written as 1.2×10^{3}, 1.20×10^{3} or 1.200×10^{3}, the claim is exact every time.

That is why only the mantissa carries significant figures. The exponent records how large the number is, not how well it was measured, so 6.022×10^{23} has four significant figures and not twenty-four.

The rules

- A number in scientific notation is **$m \times 10^{n}$** with m between 1 and 10.
- Only the **mantissa** m carries significant figures. The exponent records size, not precision.
- Moving the point **left** makes the exponent larger; moving it **right** makes it smaller.
- Converting **never** changes the number of significant figures.
- Scientific notation is the only way to write a whole number with **unambiguous** trailing zeros.
- To **multiply**, multiply the mantissas and add the exponents; to **divide**, divide and subtract.

Part A — Into scientific notation give the number and its significant figures (6 marks)

Number	Scientific notation	s.f.
45600		
0.000375		
1200.		
0.00008		
93000000		
0.0105		

Part B — Out of scientific notation (6 marks)

Scientific notation	Ordinary number	s.f.
4.07×10^{5}		

1.0×10^{3}		
4.50×10^{-3}		
2×10^{6}		
8.001×10^{-1}		
3.60×10^{2}		

Part C — Calculate leave the answer in scientific notation (8 marks)

Calculate	Working	Answer
$(3.0 \times 10^{4}) \times (2.0 \times 10^{3})$		
$(8.4 \times 10^{-3}) \div (2.1 \times 10^{2})$		
$(6.022 \times 10^{23}) \times (1.50 \times 10^{-2})$		
$(5.0 \times 10^{6}) \div (4.00 \times 10^{2})$		

Part D — Say what you mean (6 marks)

1. Write 4500 in scientific notation three times: with two, three and four significant figures. Explain why writing it as 4500 does not settle the question.

2. A student says 6.022×10^{23} has twenty-four significant figures because the number is twenty-four digits long. Explain the mistake.

Scientific Notation and Significant Figures — Answer Key

Grade 10 – 11 science · notation

Part A — Into scientific notation

1. 45600 → **4.56×10^{4}** (3 s.f.)
2. 0.000375 → **3.75×10^{-4}** (3 s.f.)
3. 1200. → **1.200×10^{3}** (4 s.f.)
4. 0.00008 → **8×10^{-5}** (1 s.f.)
5. 93000000 → **9.3×10^{7}** (2 s.f.)
6. 0.0105 → **1.05×10^{-2}** (3 s.f.)

Part B — Out of scientific notation

1. 4.07×10^{5} → **407000** (3 s.f.)
2. 1.0×10^{3} → **1000** (2 s.f.)
3. 4.50×10^{-3} → **0.00450** (3 s.f.)
4. 2×10^{6} → **2000000** (1 s.f.)
5. 8.001×10^{-1} → **0.8001** (4 s.f.)
6. 3.60×10^{2} → **360** (3 s.f.)

Part C — Calculate

1. $(3.0 \times 10^{4}) \times (2.0 \times 10^{3}) =$ **6.0×10^{7}**
   both have 2 s.f.; add the exponents
2. $(8.4 \times 10^{-3}) \div (2.1 \times 10^{2}) =$ **4.0×10^{-5}**
   both have 2 s.f.; subtract the exponents
3. $(6.022 \times 10^{23}) \times (1.50 \times 10^{-2}) =$ **9.03×10^{21}**
   1.50 has 3 s.f.
4. $(5.0 \times 10^{6}) \div (4.00 \times 10^{2}) =$ **1.3×10^{4}**
   5.0 has 2 s.f.

Part D — Say what you mean

1. **4.5×10^{3}, 4.50×10^{3}, 4.500×10^{3}.**
   Written as 4500, the two trailing zeros could be measured digits or could be holding the place, and the notation gives no way to tell. Scientific notation states the claim exactly.
2. **Only the mantissa carries significant figures.**
   The exponent records how large the number is, not how well it was measured. 6.022 has four digits, so the value has four significant figures. The twenty-three zeros were never measured by anyone.