Warm-Up | Scientific Notation and Significant Figure

Identifying Powers of Ten

Decimal Number	"Broken Down" into Tens	Powers of Ten Form
10	10	1×10^{1}
	10×10	1×10^{2}
1000	$10 \times 10 \times 10$	$1 \times \square$
	$10 \times 10 \times 10 \times 10$	1×10^{4}
100,000	$10 \times 10 \times 10 \times 10 \times 10$	$1 \times \square$
1,000,000	$10 \times 10 \times 10 \times 10 \times 10 \times 10$	1×10^{6}
1,000,000,000	$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	1×10^{9}

Identifying Powers of Ten

Decimal number	"Broken Down" into Tens	Powers of Ten Form
	1	1×10^{0}
0.1	$1 \div 10$	1×10^{-1}
0.01	$1 \div (10 \times 10)$	$1 \times \square$
	$1 \div (10 \times 10 \times 10)$	1×10^{-3}
0.0001	$1 \div (10 \times 10 \times 10 \times 10)$	1×10^{-4}
0.00001	$1 \div (10 \times 10 \times 10 \times 10 \times 10)$	1×10^{-5}
0.000001	$1 \div (10 \times 10 \times 10 \times 10 \times 10 \times 10)$	$1 \times \square$

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Warm-Up | Scientific Notation and Significant Figure

Lesson Objectives

By the end of this lesson, you should be able to:

- Write _____ in scientific notation.
- Use appropriate _____ of significant figures for calculated data.

Science Practice: Solve science-related _____ problems using scientific notation with the correct number of significant figures.

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

scientific notation	a way of writing a value as the _____ of a number, n, between 1 and 10 and a power of ten, m; $n \times 10^m$
significant figures	the digits that are known for a measurement plus one estimated _____

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Lesson Question

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Using Scientific Notation

Scientific notation – a way of writing a value as the product of a number, n, between one and [ ], and a [ ] of ten, m; $n \times 10^m$

24,000 → $n = 2.4$ → $m = 4$ → 2.4×10^4

Mass of Moon: 7.35×10^{22} kg

Mass of Earth: 5.98×10^{24} kg

Using Scientific Notation

0.000097 g

- $n = 9.7$
- $m = -5$
- 9.7×10^{-5}
- 0.000097 g
- $9.7 \times 10^{-5}\text{ g} \neq -9.7 \times 10^{5}\text{ g}$
- $-9.7 \times 10^{5} = -970{,}000$

Metric Units		
Prefix	[ ]	**Number**
mega-		**1,000,000**
kilo-	**10^3**	
	10^{-3}	**0.001**
micro-	**10^{-6}**	**0.000 001**
	10^{-9}	**0.000 000 001**

$0.000097\text{ g} = 9.7 \times 10^{-5}\text{ g} = 97\ \mu\text{g}$

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Conversion between Scientific and Standard Notation

- Write 491,000,000,000 m in scientific notation.
  - $491{,}000{,}000{,}000\ \text{m} = 4.91 \times 10^{11}$ ☐
- Write 0.0000914 L in scientific notation.
  - ☐ $\text{L} = 9.14 \times 10^{-5}\ \text{L}$
- Write 2.5×10^{5} km in standard notation.
  - $2.5 \times 10^{5}\ \text{km} =$ ☐ km
- Write $9.1 \times$ ☐ g in standard notation.
  - $9.1 \times 10^{-6}\ \text{g} = 0.0000091\ \text{g}$

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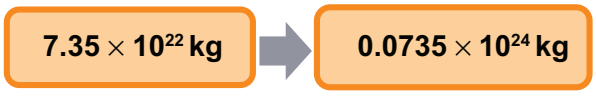
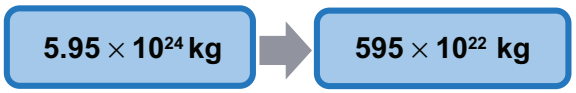
How to Add and Subtract in Scientific Notation

Exponents must be the same in order to add and subtract scientific notation.



$$0.0735 \times \square\ \text{kg}$$
$$+5.95 \times 10^{24}\ \text{kg}$$
$$6.0235 \times 10^{24}\ \text{kg}$$



$$7.35 \times \square\ \text{kg}$$
$$+595 \times 10^{22}\ \text{kg}$$
$$602.35 \times 10^{22}\ \text{kg}$$

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How to Multiply and Divide in Scientific Notation

Exponents are added or subtracted when multiplying or dividing.

Multiplying

$$(6.02 \times 10^{23})(2.0 \times 10^{3})$$
$$= (6.02)(2.0) \times 10^{23+3}$$
$$= 12.04 \times \square$$
$$= 1.204 \times 10^{27}$$

- ☐ numbers by numbers.
- Add exponents when multiplying.

Dividing

$$4.5 \times 10^{7} \div 1.5 \times 10^{3}$$
$$= \frac{4.5}{1.5} \times 10^{7-3}$$
$$= 3.0 \times \square$$

- Divide numbers by numbers.
- Subtract ☐ when dividing.

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How to Identify Significant Figures in Measurements

Significant figures – the digits that are known for a measurement ☐ one estimated digit

Mass NaCl:

- 58.4428 g
  - 6 significant figures
- 58.44 g
  - ☐ significant figures

Mass of Moon:

- 73,476,730,924,573,500,000,000 kg
- ☐ significant figures

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How to Identify Significant Figures in Measurements

Significant figures – the digits that are known for a measurement plus one estimated digit

Measurement	Significant Figures
0.00739	3
0.000739 kg	3
0.007390 kg	4

Measurement	Significant Figures
100 mL	
100.	3
100.0 mL	4

Measurement	Significant Figures
2×10^3 mol	1
2.0×10^3	2
2.00×10^3 mol	

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How to Add and Subtract with Significant Figures

The result has the same number of decimal places as the least precise number.

Adding

$$\begin{array}{r} 145.78 \\ +\ \ 6.8139 \\ \hline 152.5939 \end{array}$$

- Report with **two** [ ] places: [ ]

Subtracting

$$\begin{array}{r} 10.930 \\ -\ 2.1251 \\ \hline 8.8049 \end{array}$$

- Report with [ ] decimal places: 8.805

How to Multiply and Divide with Significant Figures

The number of significant figures in a [ ] or division problem answer matches the number with the [ ] significant figures.

Multiplying

$$(1.35)(8.062) = 10.8837$$

- [ ] with **three** significant figures: 10.9

Dividing

$$(3.0 \times 10^{8}) \div (4.35 \times 10^{-7}) = 6.8966 \times 10^{14}$$

- Report with **two** significant figures: [ ] $\times 10^{14}$

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Significant Figures in a Multistep Calculation

$$y = \frac{(3.51 + 2.1)}{(0.485)(10.64)}$$

- [ ] (one decimal place) : $3.51 + 2.1 =$ [ ] $= 5.6$
- Multiplication (three significant figures): $(0.485)(10.64) = 5.1604 = 5.16$
- [ ] (two significant figures): $y = \frac{5.61}{5.1604} = 1.087125 =$ [ ]

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Summary | Scientific Notation and Significant Figure

Lesson Question

How do scientists represent very large and small numbers and show the precision of data?

Answer

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Scientific Notation

- Measurements written in scientific notation are written as [ ] of ten.
- [ ] represent the location of the decimal place.
- [ ] involving scientific notation involves following certain [ ].
  - $n \times 10^m$
  - $n \times 10^m \pm a \times 10^m = (n \pm a) \times 10^m$
  - $(n \times 10^m)(a \times 10^b) = (n)(a) \times 10^{m+b}$
  - $n \times 10^m / a \times 10^b = n/a \times 10^{m-b}$

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Summary | Scientific Notation and Significant Figure

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Significant Figures

- Significant figures are the number of _____ in a measurement that are known plus one estimated digit.
- In reporting the result of a calculation:
  - The result should have the same decimal places as the least _____ number when _____ and subtracting.
  - The result should have the same number of significant figures as the number with the fewest significant figures when multiplying and _____.

Use this space to write any questions or thoughts about this lesson.

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