The Periodic Table of the Elements

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>He</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
<td>F</td>
<td>Ne</td>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
<td>P</td>
<td>S</td>
<td>Cl</td>
<td>Ar</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
<td>F</td>
<td>Ne</td>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
<td>P</td>
<td>S</td>
<td>Cl</td>
<td>Ar</td>
<td>K</td>
<td>Ca</td>
</tr>
<tr>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
<td>P</td>
<td>S</td>
<td>Cl</td>
<td>Ar</td>
<td>K</td>
<td>Ca</td>
<td>Sc</td>
<td>Ti</td>
<td>V</td>
<td>Cr</td>
<td>Mn</td>
<td>Fe</td>
<td>Co</td>
<td>Ni</td>
</tr>
<tr>
<td>Co</td>
<td>Ni</td>
<td>Cu</td>
<td>Zn</td>
<td>Ga</td>
<td>Ge</td>
<td>As</td>
<td>Se</td>
<td>Br</td>
<td>Kr</td>
<td>Rb</td>
<td>Sr</td>
<td>Y</td>
<td>Zr</td>
<td>Nb</td>
<td>Mo</td>
<td>Tc</td>
<td>Ru</td>
</tr>
<tr>
<td>Ru</td>
<td>Rh</td>
<td>Pd</td>
<td>Ag</td>
<td>Cd</td>
<td>In</td>
<td>Sn</td>
<td>Sb</td>
<td>Te</td>
<td>I</td>
<td>Xe</td>
<td>Cs</td>
<td>Ba</td>
<td>La</td>
<td>Ce</td>
<td>Pr</td>
<td>Nd</td>
<td>Pm</td>
</tr>
<tr>
<td>Pm</td>
<td>Eu</td>
<td>Gd</td>
<td>Tb</td>
<td>Dy</td>
<td>Ho</td>
<td>Er</td>
<td>Tm</td>
<td>Yb</td>
<td>Lu</td>
<td>Th</td>
<td>Pa</td>
<td>U</td>
<td>Np</td>
<td>Pu</td>
<td>Am</td>
<td>Cm</td>
<td>Bk</td>
</tr>
<tr>
<td>Bk</td>
<td>Cf</td>
<td>Es</td>
<td>Fm</td>
<td>Md</td>
<td>No</td>
<td>Lr</td>
<td>Rf</td>
<td>Db</td>
<td>Sg</td>
<td>Es</td>
<td>Fm</td>
<td>Md</td>
<td>No</td>
<td>Lr</td>
<td>Rf</td>
<td>Db</td>
<td></td>
</tr>
</tbody>
</table>

The Periodic Table of the Elements QUIZ
THURSDAY Oct 20
The Periodic Table of the Elements QUIZ
Thurs Oct 20

Provide the names of the following elements:

Mg
Br
Na
Fe
Pt
Se
Sb
Etc…

Prefixes-Memorize

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Name</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mega</td>
<td>M</td>
<td>$10^6$</td>
</tr>
<tr>
<td>Kilo</td>
<td>k</td>
<td>$10^3$</td>
</tr>
<tr>
<td>Deci</td>
<td>d</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>Centi</td>
<td>c</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>Milli</td>
<td>m</td>
<td>$10^{-3}$</td>
</tr>
<tr>
<td>Micro</td>
<td>µ</td>
<td>$10^{-6}$</td>
</tr>
<tr>
<td>Nano</td>
<td>n</td>
<td>$10^{-9}$</td>
</tr>
<tr>
<td>Pico</td>
<td>p</td>
<td>$10^{-12}$</td>
</tr>
</tbody>
</table>
Units

Science uses METRIC (or SI) units, not ENGLISH Quantity Common SI Unit

<table>
<thead>
<tr>
<th>Quantity</th>
<th>ENGLISH</th>
<th>METRIC (or SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>1 pound</td>
<td>453.6 grams (g)</td>
</tr>
<tr>
<td>Length</td>
<td>1 inch</td>
<td>2.54 centimeters (cm)</td>
</tr>
<tr>
<td>Volume</td>
<td>1 quart</td>
<td>0.946 liters (L)</td>
</tr>
</tbody>
</table>

Temperature

<table>
<thead>
<tr>
<th>Process</th>
<th>Fahrenheit (°F)</th>
<th>Celsius (°C)</th>
<th>Kelvin (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Boils</td>
<td>212</td>
<td>100</td>
<td>373.15</td>
</tr>
<tr>
<td>Water Freezes</td>
<td>32</td>
<td>0</td>
<td>273.15</td>
</tr>
<tr>
<td>Absolute Zero</td>
<td>-459.67</td>
<td>-273.15</td>
<td>0</td>
</tr>
</tbody>
</table>

CONVERSIONS:

Degrees F = 1.8 x Celsius + 32
Kelvin = Celsius + 273.15
Problem: Derived units

The density of gasoline is 0.78 g/mL. What is the mass (in kg) of 1 gallon of gasoline? There are 3.79 liters in one gallon. Set up the problem without solving it.

Solution:

Mass =

<table>
<thead>
<tr>
<th>1 gallon</th>
<th>3.79 L</th>
<th>1000 mL</th>
<th>0.78 g</th>
<th>kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gallon</td>
<td>1 L</td>
<td>mL</td>
<td>1000 g</td>
<td></td>
</tr>
</tbody>
</table>
Significant figures

Rules:
1. Nonzero digits are always significant

   5.345 has 4 sig. figs

2. Zeros:
   a. leading zeros do not count - 0.0025 has 2 sig.fig.
   b. zeros in between ("captive zeros") do count - 0.2005 has 4 sig.fig.
   c. trailing zeros count only if the number contains a decimal point
Significant figures

*trailing zeros count only if the number contains a decimal point*

examples:

- 100 has 1 sig. fig.
- $1.00 \times 10^2$ has 3 sig. figs
- 100. has 3 sig. figs

**Rules:**

3. Exact numbers count as infinite # of sig.fig.

example:

Say we make 4 measurements of the mass of a cigar and we get: 125 g, 126 g, 127 g, and 128 g. What is the average?
Significant figures

Answer:
Average = (125 + 126 + 127 + 128)/4 = 126.5 g
There are only 3 sig.figs in the numbers and 4 (the number of measurements) is an "exact" number. It does not limit the number of sig.figs, so the mass of the cigar we should report is = 126

Why not 127?

Rounding

In this course, if you have to eliminate “5” in a rounding operation, always round so that the final answer is even:
126.5 rounds (down) to 126
127.5 rounds (up) to 128

What about 126.52?
This number is closer to 127 than it is to 126, so it rounds up to 127.
Problem: arithmetic with significant figures

Four samples are weighed, giving values of 2.397, 951, 0.001173, and 112.55 grams, respectively. What is the number of significant digits that should be used when reporting the total mass?

a) 1
b) 2
c) 3
d) 4
e) none of the above

Solution:

\[
\begin{array}{c}
2.397 \\
951 \\
0.001173 \\
112.55 \\
\hline
1065.948173 \\
\end{array}
\]

\[= 1066 \text{ g}
\]

(4 significant digits)

(if multiplied, the answer is \(= 300.948416 = 301\), only 3 significant digits)
Problem: dimensional analysis

The biological warfare agent Botulinum toxin has a molecular weight of 150,000 g/mol. It takes approximately 0.1 µg of the toxin to kill an average person. How many grams would be needed to kill 300 million people?

a) 15,000 kg, enough to fit in a tank car
b) 1500 g, enough to fit in a suitcase
c) 300 g, enough to fit in a soda can
d) 30 g, enough to fit in an aspirin bottle
e) none of the above

\[
\frac{0.1 \mu g}{\text{person}} \times \frac{300 \times 10^6 \text{ persons}}{1 \times 10^6 \mu g} = 30 \text{g}
\]

Answer: (d)
Accuracy and Precision

**ACCURACY** = how close a measured value is to the true value.

**PRECISION** = how close you come to a given value on each measurement (i.e. reproducibility).

Errors in Measurements

**Random** (indeterminate) – noise, like tossing a coin.

**Systematic** (determinate) - something you can figure out.

Example: using a tennis ball launcher pointed at the wrong spot. If the ball launcher consistently hits a spot out of bounds, you would say that the instrument is **precise** (because it hits the same spot every time) but it is not very **accurate** (it doesn't land in the service court) and that it shows a **systematic error** (it lands out of bounds but you can adjust the ball launching system so that it delivers the serve in bounds).