### Periodic Table of the Elements

#### Atomic Properties of the Elements

**Frequently Used Fundamental Physical Constants**

- speed of light in vacuum: \( c \) = 299,792,458 m/s
- Planck constant: \( h \) = 6.626,070 \times 10^{-34} \text{ J s}
- elementary charge: \( e \) = 1.602,177 \times 10^{-19} \text{ C}
- electron mass: \( m_e \) = 9.109,384 \times 10^{-31} \text{ kg}
- electron charge: \( e \) = 1.602,177 \times 10^{-19} \text{ C}
- Rydberg constant: \( R_A \) = 10,973,731.569 \text{ m}^{-1}
- Rydberg constant: \( R_A' \) = 3,289,841,690 \times 10^9 \text{ Hz}
- Rydberg constant: \( R_A'' \) = 13,605,693 \text{ eV}
- Boltzmann constant: \( k \) = 1.380,65 \times 10^{-23} \text{ J K}^{-1}
- Boltzmann constant: \( k \) = 1.380,65 \times 10^{-23} \text{ J K}^{-1}
- Boltzmann constant: \( k \) = 8.314 \times 5.31 \text{ J K}^{-1}

#### Periodic Table

<table>
<thead>
<tr>
<th>Group</th>
<th>Period</th>
<th>Atomic Number</th>
<th>Symbol</th>
<th>Name</th>
<th>Atomic Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>He</td>
<td>Helium</td>
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<tr>
<td>2</td>
<td>2</td>
<td>10</td>
<td>Ne</td>
<td>Neon</td>
<td>10.97237</td>
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<td>3</td>
<td>18</td>
<td>Ar</td>
<td>Argon</td>
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<tr>
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<td>36</td>
<td>Kr</td>
<td>Krypton</td>
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<tr>
<td>5</td>
<td>5</td>
<td>54</td>
<td>Xe</td>
<td>Xenon</td>
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<td>86</td>
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<td>Strontium</td>
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<td>7</td>
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<td>118</td>
<td>Pb</td>
<td>Lead</td>
<td>207.2</td>
</tr>
</tbody>
</table>

#### Periodic Classification

- Group I: Alkaline Earth Metals
- Group II: Alkaline Metals
- Group III: pnictogens
- Group IV: chalcogens
- Group V: halogens
- Group VI: noble gases

#### Transition Metals

- Transition of Elements
- Transition Group Metals

#### Lanthanides and Actinides

- Lanthanides
- Actinides

#### NIST SP 966 (July 2018)

For the most precise values and uncertainties visit ciaaw.org and pml.nist.gov/data.
Cesium: The frequency of microwave radiation from this atom in atomic clocks such as the NIST-F2 (2014), is used to define the second.

NIST scientists used lasers to cool a gas of these atoms to more than theoretically expected to temperatures even closer to absolute zero. (Nobel Prize 1997)

Krypton: Wavelengths of light from this atom, measured by NIST researchers, defined the official meter until 1960.

Beryllium and Aluminum: Individual ions of these atoms were probed in a NIST trap to create “quantum logic” clocks that measured the second more precisely than before and tested Einstein’s general theory of relativity. Such quantum manipulations were recognized in the 2012 Nobel Prize.

1931

Deuterium: This rare heavy isotope of hydrogen was concentrated at NIST and then identified by Columbia University’s Harold Urey (Nobel Prize 1934). On the left is a deuterium lamp; the light on the right comes from the NIST SURF III Synchrotron Ultraviolet Radiation Facility.

Image Credit: Neil Tucker/Wikimedia

1960

Krypton: Wavelengths of light from this atom, measured by NIST researchers, defined the official meter until 1960.

Image Credit: Neil Tucker/Wikimedia

1967

Cesium: The frequency of microwave radiation from this atom in atomic clocks such as the NIST-F2 (2014), is used to define the second.

NIST scientists used lasers to cool a gas of these atoms to more than theoretically expected to temperatures even closer to absolute zero. (Nobel Prize 1997)

Image Credit: Mark Wolfe/NIST

1967

Sodium: NIST scientists used lasers to cool a gas of these atoms to more than theoretically expected to temperatures even closer to absolute zero. (Nobel Prize 1997)

Image Credit: Mark Wolfe/NIST

1988

Rubidium: These atoms were used by researchers at JILA (NIST-CU Boulder) to create the first Bose-Einstein condensate (Nobel Prize 2001).

Image Credit: NIST/JILA/CU-Boulder

2008

Potassium and Rubidium: JILA researchers married these elements into an ultracold gas of molecules and demonstrated striking predictions of quantum physics by hitting the atoms with “rulers of light” known as frequency combs (Nobel Prize 2005) and trapping them in webs of light known as optical lattices.

Image Credit: Steven Burrows and Ye/Jin groups/JILA

2010/2011

Beryllium and Aluminum: Individual ions of these atoms were probed in a NIST trap to create “quantum logic” clocks that measured the second more precisely than before and tested Einstein’s general theory of relativity. Such quantum manipulations were recognized in the 2012 Nobel Prize.

Image Credit: J. Amini/NIST

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2010