### Periodic Table of the Elements

<table>
<thead>
<tr>
<th></th>
<th>I A</th>
<th>IA</th>
<th>II A</th>
<th>IIA</th>
<th>III A</th>
<th>IVA</th>
<th>VA</th>
<th>VIA</th>
<th>V IA</th>
<th>VII A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H</td>
<td>1.008</td>
<td></td>
<td>IIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Li</td>
<td>6.94</td>
<td>4</td>
<td>Be</td>
<td>9.01</td>
<td>5</td>
<td>B</td>
<td>10.81</td>
<td>6</td>
<td>C</td>
<td>12.01</td>
</tr>
<tr>
<td>11</td>
<td>Na</td>
<td>22.99</td>
<td>12</td>
<td>Mg</td>
<td>24.30</td>
<td>13</td>
<td>Si</td>
<td>28.09</td>
<td>14</td>
<td>P</td>
<td>30.97</td>
</tr>
<tr>
<td>19</td>
<td>K</td>
<td>39.10</td>
<td>20</td>
<td>Ca</td>
<td>40.08</td>
<td>21</td>
<td>S</td>
<td>32.06</td>
<td>15</td>
<td>S</td>
<td>35.45</td>
</tr>
<tr>
<td>37</td>
<td>Rb</td>
<td>85.47</td>
<td>38</td>
<td>Sr</td>
<td>87.62</td>
<td>39</td>
<td>Y</td>
<td>39.95</td>
<td>40</td>
<td>Ti</td>
<td>40.19</td>
</tr>
<tr>
<td>55</td>
<td>Cs</td>
<td>132.9</td>
<td>56</td>
<td>Ba</td>
<td>137.3</td>
<td>57</td>
<td>La</td>
<td>140.1</td>
<td>58</td>
<td>Ce</td>
<td>140.9</td>
</tr>
<tr>
<td>87</td>
<td>Fr</td>
<td>226.0</td>
<td>88</td>
<td>Ra</td>
<td>227.0</td>
<td>89</td>
<td>Ac</td>
<td>262.0</td>
<td>90</td>
<td>Th</td>
<td>232.0</td>
</tr>
</tbody>
</table>

#### Useful Information

1 pm = 10⁻¹² m

\[ R = 0.0821 \text{ L·atm mol}^{-1} \text{K}^{-1} = 8.314 \frac{\text{J}}{\text{mol} \cdot \text{K}} \]

\[ 6.02 \times 10^{23} \]

\[ P_{\text{solute}} = \chi_{\text{solute}}P_{\text{solvent}} \]

\[ \text{density of H}_2\text{O} = 1.00 \frac{g}{\text{cm}^3} \]

\[ \Delta T = \frac{\Delta H}{k_f(H_2O)} = 1.86 \frac{^\circ C}{m} \]

\[ k_b(H_2O) = 0.512 \frac{^\circ C}{m} \]

\[ \text{edge length (l)} = 2r \]

\[ \text{edge length (l)} = 2\sqrt{2} \cdot r \]

\[ \text{edge length (l)} = \frac{4r}{\sqrt{3}} \]

\[ \Delta G^\circ = \Delta H^\circ + T\Delta S^\circ \]
<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Vapor Pressure (mmHg)</th>
<th>Temperature (°C)</th>
<th>Vapor Pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>3.2</td>
<td>50</td>
<td>92.5</td>
</tr>
<tr>
<td>0</td>
<td>4.6</td>
<td>55</td>
<td>118.0</td>
</tr>
<tr>
<td>5</td>
<td>6.52</td>
<td>60</td>
<td>149.4</td>
</tr>
<tr>
<td>10</td>
<td>9.20</td>
<td>65</td>
<td>187.5</td>
</tr>
<tr>
<td>15</td>
<td>12.8</td>
<td>70</td>
<td>233.7</td>
</tr>
<tr>
<td>20</td>
<td>17.5</td>
<td>75</td>
<td>289.1</td>
</tr>
<tr>
<td>25</td>
<td>23.8</td>
<td>80</td>
<td>355.1</td>
</tr>
<tr>
<td>30</td>
<td>31.8</td>
<td>85</td>
<td>433.6</td>
</tr>
<tr>
<td>35</td>
<td>42.1</td>
<td>90</td>
<td>525.8</td>
</tr>
<tr>
<td>40</td>
<td>55.3</td>
<td>95</td>
<td>633.9</td>
</tr>
<tr>
<td>45</td>
<td>71.9</td>
<td>100</td>
<td>760</td>
</tr>
</tbody>
</table>

**Solubility Table**

<table>
<thead>
<tr>
<th>Ion</th>
<th>Solubility</th>
<th>Exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₃⁻</td>
<td>soluble</td>
<td>none</td>
</tr>
<tr>
<td>ClO₄⁻</td>
<td>soluble</td>
<td>none</td>
</tr>
<tr>
<td>Cl⁻</td>
<td>soluble</td>
<td>except Ag⁺, Hg₂²⁺, *Pb²⁺</td>
</tr>
<tr>
<td>I⁻</td>
<td>soluble</td>
<td>except Ag⁺, Hg₂²⁺, Pb²⁺</td>
</tr>
<tr>
<td>SO₄²⁻</td>
<td>soluble</td>
<td>except Ca²⁺, Ba²⁺, Sr²⁺, Hg²⁺, Pb²⁺, Ag⁺</td>
</tr>
<tr>
<td>CO₃²⁻</td>
<td>insoluble</td>
<td>except Group IA and NH₄⁺</td>
</tr>
<tr>
<td>PO₄³⁻</td>
<td>insoluble</td>
<td>except Group IA and NH₄⁺</td>
</tr>
<tr>
<td>OH⁻</td>
<td>insoluble</td>
<td>except Group IA, *Ca²⁺, Ba²⁺, Sr²⁺</td>
</tr>
<tr>
<td>S²⁻</td>
<td>insoluble</td>
<td>except Group IA, IIA and NH₄⁺</td>
</tr>
<tr>
<td>Na⁺</td>
<td>soluble</td>
<td>none</td>
</tr>
<tr>
<td>NH₄⁺</td>
<td>soluble</td>
<td>none</td>
</tr>
<tr>
<td>K⁺</td>
<td>soluble</td>
<td>none</td>
</tr>
</tbody>
</table>

*slightly soluble