Problem 25

a) Greatest Effective Nuclear Charge (Z*)

\[ \text{Si}^{3+} > \text{Al}^{3+} > \text{Mg}^+ > \text{Na}^+ \]

b) Greatest Effective Nuclear Charge (Z*)

\[ \text{Si}^{3+} > \text{Al}^{3+} > \text{Mg}^+ > \text{Na}^+ \]

c) One way to experimentally estimate the effective nuclear charge is to measure the energy required to take an electron away. The energy will increase as Z* increases.

\[
\begin{align*}
\text{Decreasing } Z^* & \quad \text{Si}^{3+}(g) \rightarrow \text{Si}^{4+}(g) + e^- \quad I_4 = 4360 \text{kJ/mol} \\
& \quad \text{Al}^{3+}(g) \rightarrow \text{Al}^{3+}(g) + e^- \quad I_3 = 2750 \\
& \quad \text{Mg}^+(g) \rightarrow \text{Mg}^{2+}(g) + e^- \quad I_2 = 1450 \\
& \quad \text{Na}^+(g) \rightarrow \text{Na}^{2+}(g) + e^- \quad I_1 = 496
\end{align*}
\]

Problem 26

<table>
<thead>
<tr>
<th>Compound</th>
<th>Metal Ion Oxidation State</th>
<th>Electron Configuration of Metal Ion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ga₂O₃</td>
<td>Ga³⁺</td>
<td>[Ar] 3d¹⁰</td>
</tr>
<tr>
<td>GeO₂</td>
<td>Ge⁴⁺</td>
<td>[Ar] 3d¹⁰</td>
</tr>
<tr>
<td>As₂O₅</td>
<td>As⁵⁺</td>
<td>[Ar] 3d¹⁰</td>
</tr>
</tbody>
</table>

For metals and metalloids from the p-block portion of the periodic table, the most stable oxidation state tends to correspond with losing all of the valence electrons in the s and p subshells.

Problem 28

Br → [Ar] 4s² 3d¹⁰ 4p⁵  \leftarrow Adding 1 electron completely fills the 4p subshell of Br. This is a very stable configuration so the electron affinity is highly negative (exothermic).

Kr → [Ar] 4s² 3d¹⁰ 4p⁶  \rightarrow Adding an electron to Kr destroys the filled shell configuration, unfavorable, electron affinity is positive (endothermic).