1. Give the number of protons, neutrons and electrons in the following:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Protons</th>
<th>Neutrons</th>
<th>Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{177}$Hf$^{3+}$</td>
<td>72</td>
<td>105</td>
<td>69</td>
</tr>
<tr>
<td>$^{209}$Po$^{2+}$</td>
<td>84</td>
<td>125</td>
<td>82</td>
</tr>
<tr>
<td>$^{212}$At</td>
<td>85</td>
<td>127</td>
<td>86</td>
</tr>
</tbody>
</table>

2. Give the nuclear notation of the following:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Protons</th>
<th>Neutrons</th>
<th>Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{46}$Mo$^{5+}$</td>
<td>42</td>
<td>54</td>
<td>39</td>
</tr>
<tr>
<td>$^{74}$Ge$^{2+}$</td>
<td>32</td>
<td>42</td>
<td>32</td>
</tr>
<tr>
<td>$^{256}$Hs$^{2+}$</td>
<td>108</td>
<td>157</td>
<td>105</td>
</tr>
</tbody>
</table>

3. What is the name of the element, X, which has the following mixture of isotopes:

\[
\text{At. Mass} = (0.355)(192) + (0.349)(194) + (0.203)(198) + (0.093)(209)
\]

\[
= 195.50 \text{ g/mol} - Pt
\]

4. Each single orbital can hold a maximum of ___2___ electrons.

5. An “s” subshell (1 orbital) can hold a maximum of ___2___ electrons

   A “p” subshell (3 orbitals) can hold a maximum of ___6___ electrons

   A “d” subshell (5 orbitals) can hold a maximum of ___10___ electrons

   An “f” subshell (7 orbitals) can hold a maximum of ___14___ electrons

   When electrons in an atom are filling energy levels, they fill the ___lowest___ possible energy levels first.

6. Give the electron configuration for each of the following atoms and ions: (You may use core notation)

<table>
<thead>
<tr>
<th>Element</th>
<th>Electron Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si</td>
<td>[Ne] 3s$^2$ 3p$^2$</td>
</tr>
<tr>
<td>Br</td>
<td>[Ar] 4s$^2$ 3d$^{10}$ 4p$^5$</td>
</tr>
<tr>
<td>K</td>
<td>[Ar] 4s$^1$</td>
</tr>
<tr>
<td>Ge</td>
<td>[Ar] 4s$^2$ 3d$^{10}$ 4p$^2$</td>
</tr>
<tr>
<td>Na$^+$</td>
<td>[Ne] 2s$^2$ 2p$^6$</td>
</tr>
<tr>
<td>Mg$^{2+}$</td>
<td>[Ne] 2s$^2$</td>
</tr>
<tr>
<td>Br$^-$</td>
<td>[Ar] 4s$^2$ 3d$^{10}$ 4p$^2$</td>
</tr>
<tr>
<td>O$^{2-}$</td>
<td>[Ne] 2s$^2$ 2p$^6$</td>
</tr>
</tbody>
</table>
7. Write the configuration and then find the number of valence electrons for the following atoms:

N (configuration) \[ \text{[He]} 2s^2 2p^3 \] (# of valence e’s) 5

Si (configuration) \[ \text{[Ne]} 3s^2 3p^2 \] (# of valence e’s) 4

Ca (configuration) \[ \text{[Ar]} 4s^2 \] (# of valence e’s) 2

P (configuration) \[ \text{[Ne]} 3s^2 3p^3 \] (# of valence e’s) 5

Al (configuration) \[ \text{[Ne]} 3s^2 3p^1 \] (# of valence e’s) 3

---

On the following diagram of the Periodic Table, list the number of valence electrons and the most common ion charge in Groups 1, 2 & 13-18

![Periodic Table Diagram]

8. In order to become stable, an atom of Ca will **donate** 2 electrons and become the ion **Ca^{2+}**

an atom of Se will **gain** 2 electrons and become the ion **Se^{2-}**

an atom of K will **donate** 1 electron and become the ion **K^+**

an atom of Br will **gain** 1 electron and become the ion **Br^-**

an atom of N will **gain** 3 electrons and become the ion **N^{3-}**

an atom of As will **gain** 3 electrons and become the ion **As^{3-}**

an atom of Al will **donate** 3 electrons and become the ion **Al^{3+}**

an atom of Te will **gain** 2 electrons and become the ion **Te^{2+}**
9. What is the general trend in atomic radius (size of atoms) as you move from left to right across any Period? (increase/decrease) _______________ decrease _______________

10. As you move from Li to Ne, electrons are filling (the same/different) _______________ energy levels(s). This may help explain why atoms don’t get bigger as you move to the right within a period.

9 protons while NO increase in shielding (no more core electrons)

11. As you move across from Li to Ne, what is happening to the number of protons in the nucleus? _______________. What do the protons do to the electrons? _______________. Suggest a reason why the atoms in a period actually get smaller as you move from left to right.

12. What is the general trend in atomic radius (size of atoms) as you move down a vertical column (group)? (increase/decrease) _______________ increase _______________

13. Suggest a reason for this trend. (Hint: are electrons filling up the same energy level (orbitals) as you move down a column?) No! Every new row means +1 energy level!

14. What is meant by ionization energy?

The amount of E required to remove an e^- from the outer most shell

15. What is the general trend in first ionization energy as you move from left to right across any Period? (eg. from Li→Ne or from Na→Ar) (increase/decrease) _______________

16. Keeping in mind the trend in atomic radius as you move from left to right across a period, suggest a reason for this trend in ionization energies. (Hint: What happens to the distance and the force of attraction between the nucleus and the outer electron as atoms get smaller?) 9 protons increase attractive force → harder to remove e^-.

17. What is the trend in ionization energy as you move down a vertical column, like from Li→Na→K or from He→Ne→Ar→Kr? (increase/decrease) _______________

Suggest a reason for this trend based on atomic radius (size) and the distance and force of attraction between the nucleus and the outer electron.

While attract increases so does shielding + distance overall attractive force goes ↑

18. Compare the following particles:

<table>
<thead>
<tr>
<th>sodium ion</th>
<th>oxide</th>
<th>neon</th>
<th>Magnesium atom</th>
<th>Fluorine atom</th>
</tr>
</thead>
</table>

a. Arrange the particles using chemical formulas from smallest atomic radii to largest atomic radii:

b. On your answer above, using arrows show the trend of electronegativity, ionization energy and electron affinity.
Draw Lewis Structures (Electron-dot diagrams) for the following ionic compounds:

a) CaF$_2$

\[
\text{Ca}^+ \quad \text{F}^-
\]

b) AlF$_3$

\[
\text{Al}^3+ \quad [\text{F}^-]^3
\]

19. Draw Lewis Structures (Electron-dot diagrams) for the following covalent compounds.

a) NH$_3$

\[
\text{H} - \text{N} - \text{H}
\]

b) ClF$_4^-$

\[
: \text{F} - \text{Cl} - \text{F} - \text{F}
\]

c) NO$_3^-$

\[
\text{N} = \text{O} - \text{O} - \text{O}
\] (2x resonance)

d) PF$_3$

\[
: \text{F} - \text{P} - \text{F} - \text{F}
\]

e) CH$_3$CH$_2$CH$_3$

\[
\text{H} - \text{C} - \text{C} - \text{H}
\]

f) N$_2$Br$_4$

\[
\begin{array}{c}
\text{Br} - \text{N} - \text{N} - \\
\text{Br} & \text{Br} & \text{Br} & \text{Br}
\end{array}
\]

g) H$_2$S

\[
\text{H} - \text{S} - \text{H}
\]

h) SeCl$_2$

\[
: \text{Cl} - \text{Se} - \text{Cl}
\]

i) BH$_4^-$

\[
\text{H} - \text{B} - \text{H}
\]

j) SF$_5$$_-$

\[
: \text{F} - \text{S} - \text{F} - \text{F} - \text{F}
\]