1) Provide the electron configuration for the following ions. You may use the noble gas configuration shorthand. 
   0.5 pts each
   a) $\text{Al}^{3+}$ [Ne] or [He]2$^2$s$^2$p$^6$
   b) $\text{Br}^-$ [Kr] or [Ar]4s$^2$3d$^{10}$4p$^6$

2) For each of the following provide the number of valence and the number of core electrons. 
   a, b, c each worth 0.5 pt
   a) $\text{N}$ valence ______ core ______
   b) $\text{V}$ valence ______ core ______
   c) $\text{Mg}^{2+}$ valence ______ core ______

3) Provide the chemical equation for the electron affinity of $\text{Se}^-$. Include phases and charges!
   $\text{Se}^- (g) + e^- \rightarrow \text{Se}^2^- (g)$

4) The first and second ionization energies of $\text{K}$ are 419 kJ/mol and 3052 kJ/mol. The first and second ionization energies of $\text{Ca}$ are 590 kJ/mol and 1145 kJ/mol. Compare these values and explain the differences. 
   1.5 pts
   The first ionization energy for $\text{K}$ is less than $\text{Ca}$ because $\text{Ca}$ has a larger effective nuclear charge. There is a large increase in the second ionization energy for $\text{K}$ compared to $\text{Ca}$ because removal of the second electron from $\text{K}$ is a core electron that is in a quantum shell closer to the nucleus. The second electron removed from $\text{Ca}$ is still a valence electron, in the same (highest) principal quantum shell as the first.

5) Indicate whether the following statements about ionization energy are true (T) or false (F). 
   0.5 pts each
   F  a) The second ionization energy for $\text{Ca}$ is less in magnitude than the first ionization energy.
   T  b) Removal of one electron from a calcium atom is an endothermic process.
   F  c) The energy required to remove one electron from strontium is greater than that required to remove one electron from tin.

6) In terms of nuclear charge and electron position, describe why the effective nuclear charge increases from left to right across the periodic table and decreases from top to bottom. 
   1.5 pts
   Going from left to right, the number of protons and electrons increases. The additional electrons are in the same principal quantum shell and are roughly the same distance from the nucleus and thus are all subject to the attractive force of the additional protons.
   Going from top to bottom, there is also an increase in the number of protons and electrons. However, the additional electrons are in a principal quantum shell that is farther out and despite the fact that there are more protons, the electrons are shielded from them by inner shell electrons.

7) The process of adding an electron to $\text{Ar}$ is endothermic. This is because
   a) Energy is required to pair electrons
   b) Energy is required to add the first electron to a p orbital
   c) Energy is required to add an electron to a new principal shell
   d) Energy is required to remove a proton
8) Circle the choice in each pair below that would have the highest electron affinity.
0.5 pt each
a) As or Br  
b) S or Te

9) In each group below, circle the atom or ion with the smallest atomic radii.
0.5 pts each
a) Na La S  
b) O²⁻ Se²⁻ Te²⁻  
c) As⁺³ As As³⁻  
d) Se²⁻ Kr Sr²⁺

10) Coulomb's law is as follows:  \( E = 2.31 \times 10^{-19} \text{ J} \times \text{nm} \times (q_1)(q_2)/r \)
According to this law, which of the following ionic compounds would have the largest energy of attraction.

a) Al³⁺ and Mg²⁺  
b) Cl⁻ and O²⁻  
c) Mg²⁺ and O²⁻  
d) Al³⁺ and O²⁻

11) The bond length is the distance between two nuclei at which the energy is
( at a minimum zero at a maximum )

12) Which element has a cation that has a +3 charge and six 3d electrons?
Co

13) The difference between the expected bond energy and actual bond energy for H-X is 367 kJ/mol.
The difference between the expected bond energy and actual bond energy for H-Q is 59 kJ/mol.
Which bond below is more likely to be H-X?
0.5 pt
a) H – O  
b) H-C

14) The ability of an atom to attract shared electrons to itself is called
a) electronegativity  
b) electron affinity  
c) ionization  
d) electroselpish

15) For the elements K, P, and O, which answer below presents these from least to most electronegative.
0.5 pt
a) K < P < O  
b) O < P < K  
c) P < K < O  
d) K < O < P

16) Which of the following covalent bonds would be expected to be the most polar?

a) N-I  
b) N-Br  
c) N-Cl  
d) N-F

17) In each pair below, select the ionic compound that would have the greatest covalent character.

a) NaCl or NaI  
b) KCl or CsCl

18) Which of the following places the following atoms and ion in the order of largest to smallest.

<table>
<thead>
<tr>
<th>O²⁻</th>
<th>Al³⁺</th>
<th>Ne</th>
<th>Ar</th>
<th>Cl⁻</th>
<th>Ca²⁺</th>
</tr>
</thead>
</table>
| a) O²⁻ Cl⁻ Ar Ne Ca²⁺ Al³⁺  
b) O²⁻ Ne Al³⁺ Cl⁻ Ar Ca²⁺  
c) Al³⁺ Ca²⁺ Ne Ar Cl⁻ O²⁻  
d) Cl⁻ Ar Ca²⁺ O²⁻ Ne Al³⁺  
e) Ar Ne Cl⁻ O²⁻ Al³⁺ Ca²⁺ |