Multiple choice (6 points each). Pick the best and most complete answer.

1. Which of the following elements’ valence electrons feel the least effective nuclear charge?
   a. Cl   d. P   g. Sr
   b. F   e. As   h. Se
   c. B   f. Rb   i. They’re all equal

2. Which of the following correctly orders the elements by 1st ionization energy, (from lowest (least positive or most negative) to highest (most positive or least negative)).
   a. Na, K, Rb, In, Sn, Sb   d. K, Na, Si, P   g. a and b
   b. S, P, Si, Al   e. Ne, Ar Kr, Xe   h. c and d
   c. Ar, Cl, S, Mg, Na   f. None of the above  i. all of the above

3. Which lists the elements in the order of the number of their valence electrons (from lowest to highest):
   a. Li, Cl, Cr, Cd   d. Li, Cd, Cr, Cl   g. Cd, Cr, Li, Cl
   b. Cd, Cr, Cl, Li   e. Li, Cl, Cd, Cr   h. Cr, Cd, Li, Cl
   c. Li, Cr, Cl, Cd   f. Cd, Cl, Cr, Li   i. Cr, Li, Cd, Cl

4. Which of the following properly lists the atoms in order of size from largest to smallest?
   a. Br, Cl, Al, Na   d. I, Br, Cl, F   g. b and d
   b. K, Ca, Se, Br   e. all of the above   h. b and c
   c. F, Cl, Br, I   f. a, c and d   j. none of the above

5. Though the electron affinity changes gradually across the periodic table, there are discontinuities where the general trend across a row does not hold. Between which elements are such discontinuities seen?
   a. Between Na and Mg   d. Between Si and P   g. Between Cl and Ar
   b. Between Mg and Al   e. Between P and S   h. b, e and g
   c. Between Al and Si   f. Between S and Cl   i. a, d and g
   j. None of the above

6. For each element, there are always points at which the nth ionization energy is significantly different from the n+1th ionization energy. Predict where such large jumps will occur for the element phosphorous (P).
   a. Between the 1st and 2nd ionization energies
   b. Between the 2nd and 3rd ionization energies
   c. Between the 3rd and 4th ionization energies
d. Between the 4th and 5th ionization energies
e. Between the 5th and 6th ionization energies
f. Between the 6th and 7th ionization energies
g. None of the above.

7. Which of the following orders the elements in order of their electron affinity, from highest (most positive or least negative) to lowest (most negative or least positive)
a. P, S, Cl, Ar
c. Ne, F, O, N
e. None of the above
g. a and b
b. Cl, F, O, N
d. N, O, F
f. All of the above
h. c and d

8. Between which of the following atoms would you predict a covalent bond to be formed
a. Ca and Ca
d. Ca and Mg
g. b and f
b. Ag and S
e. F and F
h. a, b and f
c. Na and Cl
f. Br and N
i. e and f
j. None of the above

9. Which of the following lists the elements in order of their electronegativity, from lowest to highest?
a. Cl, F, O, N
d. Te, I, Br, Cl
g. b and d
b. Na, Mg, S Cl
e. F, Cl, Br, I, At
h. b, c and d
c. Si, C, B, Be,
f. None of the above
i. d and e

10. Which of the following do you expect to most violently react with water to give a cation?
a. Li
d. Na
g. Sr
b. Be
e. K
h. None react with water
c. Mg
f. Rb
i. They are all the same

11. (11 points) Using the table of bond enthalpies, calculate the ΔH for the following reaction:

Acetylene + 2Br₂ → tetrabromoethane

\[
\begin{align*}
\text{H} & \quad \equiv \quad \equiv \quad \text{C} \quad + \quad 2\text{Br}_2 \quad \rightarrow \quad \text{H} \quad \equiv \quad \equiv \quad \text{C} \quad + \quad 2\text{Br}_2 \\
\end{align*}
\]
For the following, draw correct Lewis structures showing any formal charges and resonance structures. For each molecule, give the geometry, shape and hybridization of the central atom in the molecule and whether the molecule is polar or non-polar (has a dipole moment). (9 points each)

12. The carbonate ion CO$_3^{2-}$.

trigonal tringonal sp2 non polar

13. BrF$_3$

2 lone pairs of electrons

tbp, t shaped, sp3d, polar

14. PF$_3$

1 lone pair, tet, trig pyramid, sp3, polar
15. XeF₄
2 lone pairs, oct, square planar, non polar, sp3d2

16. PCl₅
tbp, tbp, non polar sp3d

17. SF₄

tbp, see saw, sp3d, polar,

18. H₂O
tet, bent, sp3, polar

19. ICl₄⁻
2 lone pairs, oct, sq. planar, sp3d₂, non polar

20. The formate ion.
Dumped.