

1 Cognitive reasoning in the chemical sciences 4.6

1. Please determine the answer to the following questions, stating briefly the reason or facts on which your answer is based.
 - (a) Which is greater: the electronegativity of fluorine or phosphorous?
 - (b) Which has a greater Z_{eff} : fluorine or boron?
 - (c) If the valence electron principal quantum number, n , are the same for elements D and E, but Z_{eff} is larger for D, is element D or E the larger atom?
 - (d) Which is larger: a neutral fluorine atom or a neutral oxygen atom?
 - (e) Which has a greater valence electron principal quantum number: sulfur or calcium?
 - (f) Which has a greater Z_{eff} : calcium or sulfur?
 - (g) Which is greater: the electronegativity of chlorine or beryllium?
 - (h) If Z_{eff} for atoms D and E are exactly the same, but the valence electron principle quantum number is a smaller value for element D, is D or E the more electronegative atom?
 - (i) Which is larger: a neutral fluorine atom or an oxygen monoanion?
 - (j) If the electronegativity of element D is greater than that of element E, which of the two most probably has a bigger ionization potential?
 - (k) When the octet rule is obeyed, which neutral atom makes more bonds: silicon or bromine?
 - (l) Which is larger: a neutral fluorine atom or a neutral neon atom?
 - (m) Which is larger: fluorine gas or neon gas?
 - (n) Which is denser at STP: fluorine gas or neon gas?
 - (o) Which is greater: the electronegativity of gold or silver?
 - (p) Which is greater, the first or the second ionization potential for the same atom?
 - (q) For which column in the periodic table is the difference between the first and second ionization potential the greatest?
 - (r) Which two are equal: the electronegativity of fluorine, nitrogen, or chlorine?
 - (s) Which is larger: neutral iron or copper?
 - (t) Which is greater: the electronegativity of cobalt or manganese?
 - (u) Excluding the noble gas elements, what is the second-most electronegative element?
 - (v) Which is denser at STP: iron or copper?
2. Please draw Lewis structures for the following molecules and ions:
 - (a) ammonia.
 - (b) acetone, CH_3COCH_3 (there are no rings in this molecule).
 - (c) cyanogen, NCCN (there are no rings in this molecule).

- (d) bleach.
 - (e) steam.
 - (f) C_2H_6 , ethane.
 - (g) S_8 . Assume all sulfur atoms are chemically equivalent.
 - (h) P_4 , white phosphorus. All P atoms are chemically equivalent.
 - (i) N_2
 - (j) F_2
 - (k) O_2
 - (l) Explain why S_2 is not a stable molecule under ordinary conditions.
3. If the octet rule is obeyed:
- (a) How many bonds does a neutral silicon atom have in a stable compound?
 - (b) How many bonds does a Si^{-3} atom have in a stable compound?
 - (c) How many bonds does a neutral tellurium atom have in a stable compound?
 - (d) How many bonds does an S^{2-} atom have in a stable compound?
 - (e) How many bonds does a N^+ atom have in a stable compound?
 - (f) How many bonds does a Kr^{4+} atom have in a stable compound?
4. What are the steric numbers, the molecular shapes and the oxidation states of the most central atom in the following molecules or ions:
- (a) POCl_3
 - (b) the sulfate ion.
 - (c) SO_2Cl_2
 - (d) the phosphate ion.
 - (e) S_2F_2
 - (f) sulfuric acid.
 - (g) the nitrate ion.
 - (h) nitric acid.
 - (i) hydrochloric acid.
 - (j) phosphoric acid.
 - (k) KrO_2F^+
 - (l) XeO_3
 - (m) IOF_5
 - (n) OClF
 - (o) I_3^-
 - (p) SO_2F_2