Week 10 chapt 7-8 practice problems   (do these then check the solutions below)

(1) Supposing that the work function (i.e. binding energy of the electrons) of a photoemissive metal is 3.32×10^{-19} J/e⁻. Would 500 nm photons be capable of ejecting electrons by the photoelectric effect? If so, what would the maximum kinetic energy be for the electrons?

(2) a) Write the electron configuration of phosphorus (atomic # 15) and of sulfur (atomic # 16). [2 pts]

b) Of the two, which one would you expect to have the lower first ionization energy? Explain. (hint: use "orbital box" diagrams if you wish) [1pt]

 (3) Draw the Lewis structure of

a) CH_3NO and indicate the polar bonds with an arrow.   [2 pts]

b) nitrous ion, NO_2^-. Write down the formal charges of both N and O in your structure [2 pts]

_____ (4) How many electrons are around the sulfur atom in the best Lewis structure for SF_4?

        a) 4   b) 6   c) 8   d) 10   c) 12

_____ (5) Which structure is best for the cyanate ion, NCO⁻ ?

a)   :N̄ - C≡O: b) :N≡C- Ō: c) :N̲=C=O̲:   d) N̲≡C= O̲: e) :N̲=C=O:

_____ (6) Which of the following does NOT violate the octet rule?
        a) NO   b) NO_2 c) NO_2^+ d) ClF_3 e) BF_3

Solutions:
(1) Solution: get the energy of the photons:
$E = hc/\lambda = (6.63 \times 10^{-34} Js)(3.00 \times 10^8 m/s)/(500 \times 10^{-9} m) = 3.98 \times 10^{-19} J > 3.32 \times 10^{-19} J$
Since the photon has more energy than the binding energy, then electrons will be emitted with a kinetic energy maximum equal to the difference of these 2 energies:
$3.98 \times 10^{-19} J - 3.32 \times 10^{-19} J = 6.6 \times 10^{-20} J$

(2) (a) $_{15}P$: $1s^2 2s^2 2p^6 3s^2 3p^3$ $_{16}S$: $1s^2 2s^2 2p^6 3s^2 3p^4$
(b) Of the two, S will have the lower first IE because it will have one 3 p orbital which is occupied by a pair of electrons. The electron pair repulsion could make it easier to remove the first electron for S when compared to the first electron for P.

                         H

(3) The best structure will be: H C-$\underline{N}$=$\underline{O}$:   (the C→N bond and the N→O bonds are polar)
                                  H _

The best structure for NO_2^- will be :$\underline{O}$-$\underline{N}$=$\underline{O}$:   the formal charges are given below the atoms:
                                  -1 0   0

(4) D   (5) B   (6) C