

CHEM 1101 – Mock midterm for fall 2015 - 75 minutes

1. Magnesium has an ionization energy of 738 kJ/mol. Determine the wavelength of electromagnetic radiation needed (the maximum effective wavelength) to cause magnesium to exhibit the photoelectric effect. Give the value in nanometers.

162 nm

2. a) Rank the following in order of increasing atomic size (atomic radius):

Cl, F, K, Mg, Ne, P, S, Si $Ne < F < Cl < S < P < Si < Mg < K$

- b) Rank the same elements from part a in order of increasing ionization energy:

Cl, F, K, Mg, Ne, P, S, Si $K < Mg < Si < S < P < Cl < F < Ne$

- c) For Sulfur, S, write the chemical equations showing the **first** and **second** electron affinity reactions.



3. a) Give the electron configuration for gold, ${}_{79}Au$

$Au: [Xe] 6s^1 4f^{14} 5d^{10}$

- b) List the valence subshell(s) for gold $6s^1$

Show the orbital diagram for the valence subshell(s) $\underline{1}$

Give the full set of quantum numbers for all electrons in the valence subshell(s). $(6, 0, 0, 1/2)$

- c) List the highest energy subshell for gold, $5d^{10}$

Show the orbital diagram for the highest energy subshell if different from above $\uparrow\downarrow \uparrow\downarrow \uparrow\downarrow \uparrow\downarrow \uparrow\downarrow$

Give the full set of quantum numbers for all electrons in the highest energy subshell if different from above.

$(5, 2, -2, \pm 1/2) (5, 2, -1, \pm 1/2) (5, 2, 0, \pm 1/2) (5, 2, 1, \pm 1/2) (5, 2, 2, \pm 1/2)$

- d) Give the electron configuration for the Au(I) ion

$[Au]^+ : [Xe] 4f^{14} 5d^{10}$

4. For the phosphate ion, PO_4^{3-}

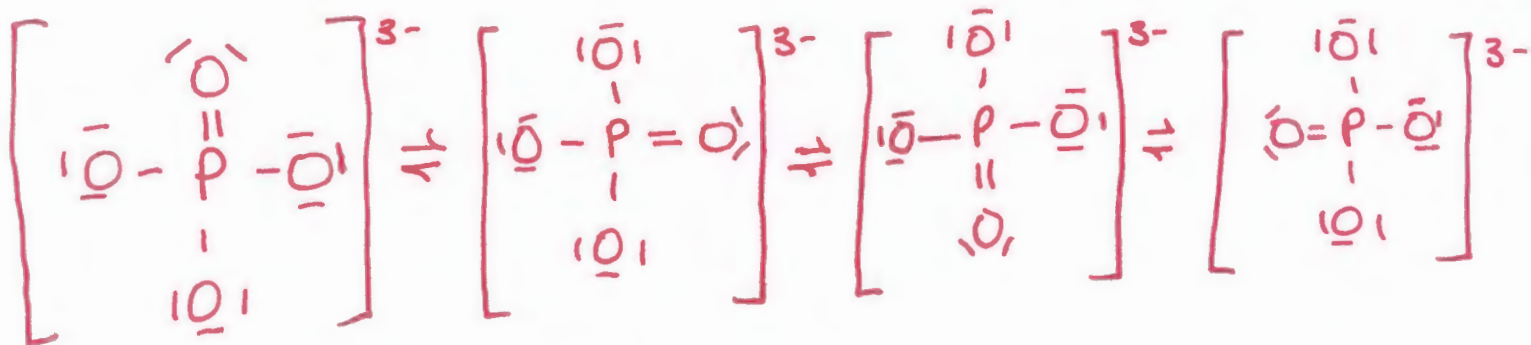
a) Show the Lewis Diagram

b) Give each bond order

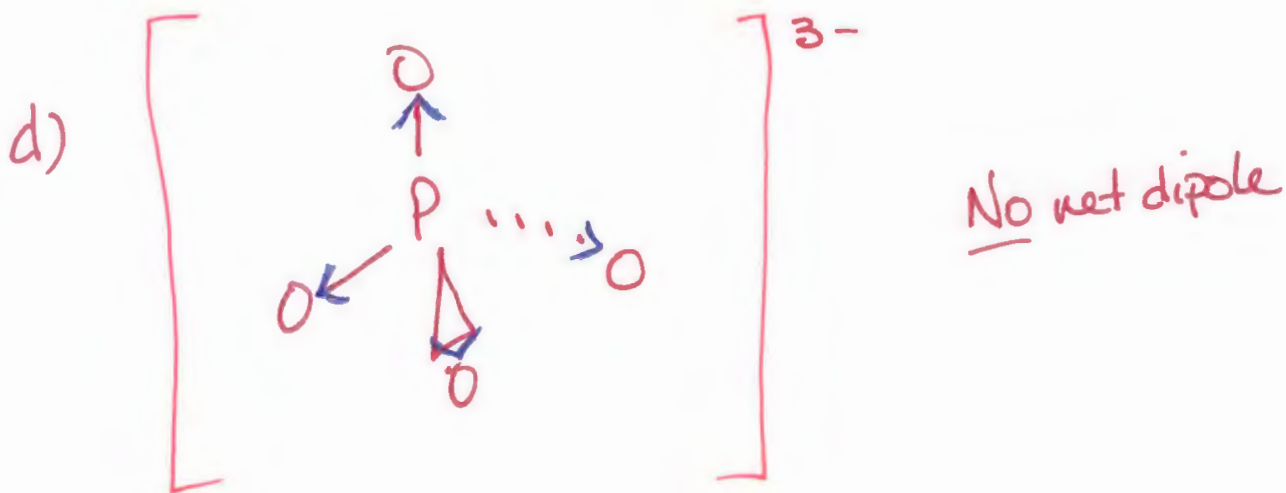
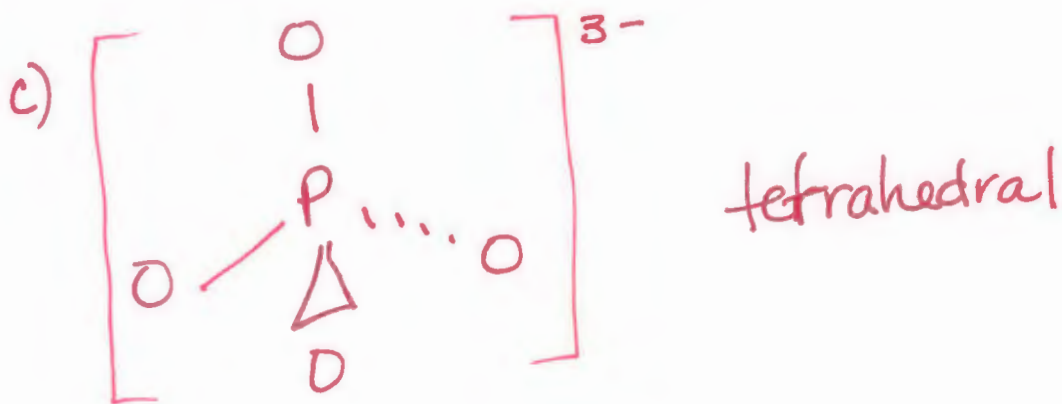
c) Draw and name the molecular geometry

d) Show the bond dipoles and net dipole

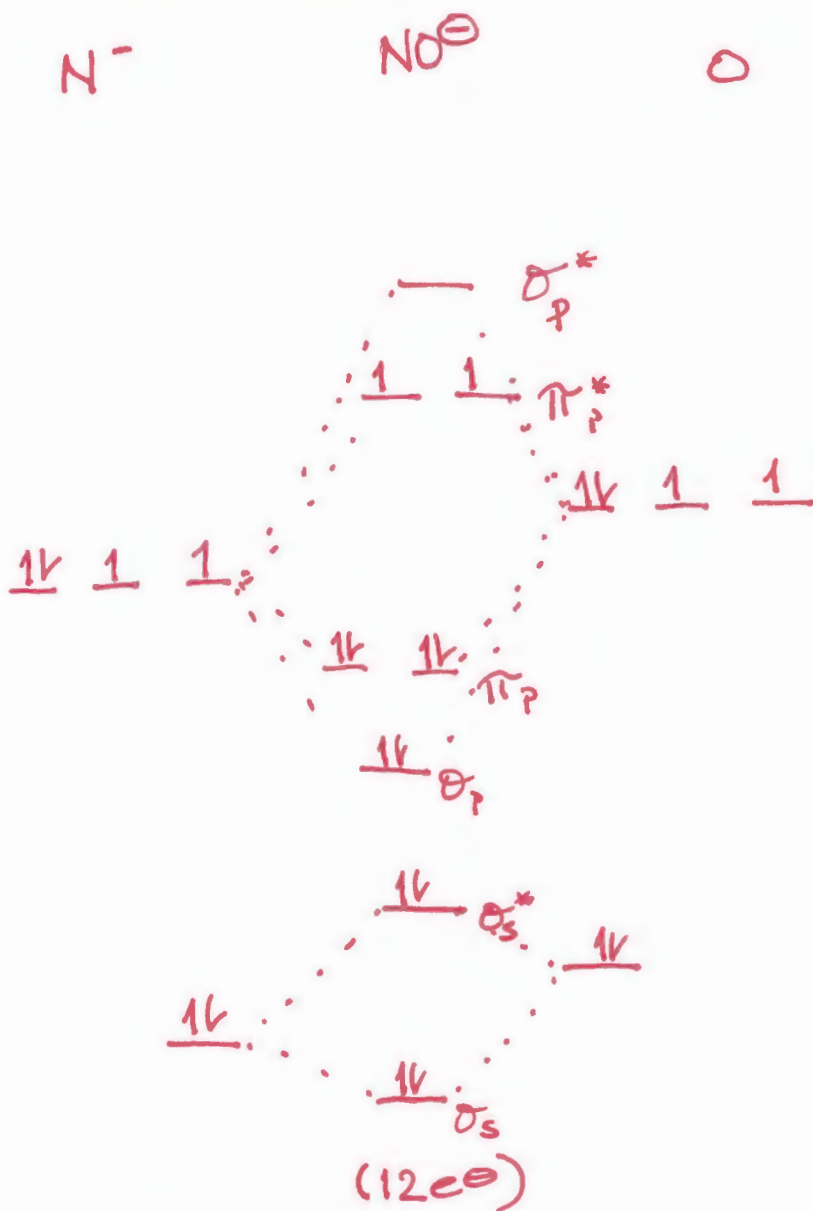
a)



b) each bond: $5/4$ or $1\frac{1}{4}$ or 1.25



5. a) Draw and label a molecular orbital diagram for the NO^- ion (use at least half a page! – if it's too small for us to read YOU WILL NOT GET CREDIT FOR IT!)
- b) Give the bond order types and overall bond order
- c) Give the magnetism – explain the reason for your choice briefly (a few words is plenty)



b) σ bonds: $\frac{4-2}{2} = 1$

π bonds: $\frac{4-2}{2} = 1$ \rangle Overall Bond Order = 2

c) Paramagnetic – there are unpaired electrons.