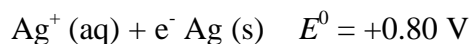
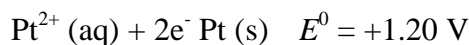


CHEMISTRY 313

Test 1, Tuesday, September 29, 1998, 12:30 pm - 1:45 pm

- (1.) (a) Please name 3 properties of atoms which change as you cross a period?
 (b) Please draw the *d*-orbital splitting diagrams for $[\text{FeCl}_4]^-$ and $[\text{RuCl}_4]^-$. What are the theoretical magnetic moments for these ions?
 (c) Please draw the molecule XeF_2 according to the shape predicted by VSEPR.
 (d) For POCl_3 , assume that a π -bond exists between P and O; what is the hybridization at O and at P? Please draw a diagram showing all the orbitals involved in the bonding between O and P.
 (e) What fundamental property of the saline hydrides betrays their ionic nature? Why are the electropositive elements the only ones to form truly ionic hydrides?
- (2.) (a) Please draw a Lewis structure of the molecule N_2O_4 (which has a formal single N-N bond) showing formal charges and possible resonance structures. What is the formal oxidation number of N? What is the occupancy at N? Please explain why there is not a double bond. The covalent radius of N is 0.72 Å; the actual N-N bond length in N_2O_4 is found to be 1.80 Å, however. Please consider the formal charges on each N in your explanation of why the single bond is so unexpectedly long.
 (b) Please show the Lewis structures of the products of the heterolytic cleavage of the N-N bond in N_2O_4 . Please show the shapes of these products.
 (c) Please consider the information below to calculate the average N-O bond strength in N_2O_4
 $B(\text{N}=\text{N}) = + 946 \text{ kJ/mol}$
 $B(\text{O}-\text{O}) = + 146 \text{ kJ/mol}$
 $B(\text{N}-\text{N}) = + 160 \text{ kJ/mol}$
 $\Delta H_f^0 \text{ N}_2\text{O}_4 (\text{g}) = + 9.2 \text{ kJ/mol}$
 (d) Please assign oxidation numbers for *all* atoms in the following species: HF_2^- , NF_4^+ , UO_5^{4-} , N_2H_2 , O_2F_2 (peroxide-type structure)
 (e) Please give the short-hand ground-state electronic configurations of: Ni^{3+} , Mo^{5+} , Gd^{3+} , Rb^- , Xe^+ .
 (f) Please predict which will be the cathode and anode in a galvanic cell composed from the following standard electrode reactions:



What will be the cell potential under standard conditions?

What is the standard free energy of the cell in kJ? (volts = joules/coulombs)

Please write the short-hand notation for the galvanic cell.

What would be the cell potential if $[\text{Ag}^+ (\text{aq})] = 0.025 \text{ M}$, and $[\text{Pt}^{2+} (\text{aq})] = 0.160 \text{ M}$?

What is the cell potential at equilibrium?