Chemistry 1B, Fall 2015 Make Up Quiz Ver A KEY (Not copied by mistake)

Each question worth 2 points

Strong ligands: $CN^- > NO_2^- > en > NH_3$ **Weak ligands:** $H_2O > OH^- > F^- > Cl^- > Br^-$

1. In the coordination complex, $[Ag(NH_3)_2]^+$, the electrons binding the Ag^+ to the NH_3 come from
a) the Ag^+ 5s electrons b) the Ag^+ 4d electrons
c) the NH_3 2s electrons d) the NH_3 lone pair electrons
Ag^+ has no valence (5s) electrons, so bonding electrons must come from ligand and comes from ligand lone pair.

2. If a coordination complex has bidentate ligands and octahedral geometry, how many ligands does it have?
a) 1 ligand b) 2 ligands c) 3 ligands d) 4 ligands e) 6 ligands
bidentate means two bonds per ligand, octahedral means 6 bonds, so 6/2 = 3 bonds per ligand

3. The complex $[Co(NO_2)_6]^{4-}$ will have how many unpaired d electrons:
a) 0 b) 1 c) 2 d) 3 e) 4
Co^{2+} is a d^7 metal. NO_2^- is a strong ligand leading to a low spin state with 6 paired off-axis d electrons and 1 unpaired on-axis d electron

4. The coordination complex $[Ni(en)_3]^{2+}$ absorbs yellow light (at 560 nm). Calculate Δ in kJ/mol. Constants: h = Planck's constant = 6.63×10^{-34} J·s, c = speed of light = 3.00×10^8 m/s and Avogadro's Number = 6.02×10^{23}.
a) 214 kJ/mol b) 0.214 kJ/mol c) 21 kJ/mol d) 83,113 kJ/mol
$E = hc/\lambda = (6.63 \times 10^{-34}\ J{\cdot}s)(3.00 \times 10^8\ m/s)/(560 \times 10^{-9}\ m) = 3.55 \times 10^{-19}\ J/complex$
$E = (3.55 \times 10^{-19}\ J/complex)(6.02 \times 10^{23} complex/mol)(1\ kJ/1000\ J) = 214\ kJ/mol$

5. Which coordination compound will absorb light at the longest wavelength?
a) $[ZnCl_4]^{2-}$ b) $[Fe(H_2O)_6]^{2+}$ c) $[Fe(H_2O)_6]^{3+}$ d) $[FeBr_6]^{4-}$
last complex has weakest ligand and is Fe^{2+} (causes smaller gap than more highly charged Fe^{3+})