1. Write the electron configurations for (a) $_{39}Y$ (b) $_{57}La^{3+}$. (4%)
2. How many nodes will you expect in the radial wave function of a 4d orbital ($0<r<\infty$)? Why? (4%)
3. For Cl and Br atoms, which has the higher electron affinity? Why? (4%).
4. For $CaCl_2$ and $HgCl_2$, which has the higher melting point? Why? ($r_{Ca^{++}} \approx r_{Hg^{++}}$, $_{20}Ca$, $_{80}Hg$). (6%)
5. Write a reasonable Lewis structure and assign formal charges for ClF_3. (4%)
6. Draw the $sd_{x^2-y^2}$ hybrid orbitals (indicating the sign of the amplitude of the wave function). (6%)
7. Compare the relative stability toward reduction by water for $[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$ and explain it. (4%)
8. Why is $(\pi\text{-}C_5H_5)_2Fe^+PF_6^-$ a good oxidizing reagent while $(\pi\text{-}C_5H_5)_2Co$ is a good reducing reagent? (6%)
9. How do you distinguish a coordinated NO group as either a one-electron or three-electron donor in metal complexes structurally? (4%)
10. In trans-$pt(PPh_3)_2(Cl)(\eta^1\text{-}\overset{O}{\overset{\|}{C}}\text{-}\overset{O}{\overset{\|}{C}}\text{-}CH_3)$, the carbonyl group bonded to the pt atom has lower stretching frequency than the other. Explain. (5%)
11. Determine the point group of the following: (5%)
(a) ClF_2H (b) SO_4^{-2} (c) planar $B(OH)_3$ (d) F_3PH_2 (e) $H_2C=C=CH_2$
12. Explain why Mn_3O_4 is a normal spinel while Fe_3O_4 is an inverse spinel. (6%)
13. Explain why $Mn(H_2O)_6^{2+}$ is almost colorless while MnO_4^- is a deep purple ion. (4%)
14. Explain why $Re_2Cl_8^{2-}$ is not a staggered but an eclipsed form structurally. (5%)
15. Why is $[Co(NH_3)_6]^{3+}$ reduced much less rapidly than $[Co(NH_3)_5Cl]^{2+}$ by hexaquochromium(II) ions? (4%)

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16. Regarding electronic transitions in inorganic Chemistry:
(a) It is a common observation that 4d complexes have d-d transition energies about 10,000 cm^{-1} higher than those of 3d complexes. Give one or more fundamental reasons for this difference. (4%)
(b) $[RhCl_6]^{3-}$ has transition $^1A_{1g} \rightarrow {}^1T_{2g}$ at 24.3 kK, which is, however, forbidden. Explain the presence of the band in a concise manner. (4%)

17. The B-F bond length in amine-BF_3 complexes is longer than in BF_3 itself. Explain. (5%)

18. Which of the following compounds would you expect to be colored? Explain your answers. (4%)
Al_2O_3, Al_2S_3, $AgCl$, AgI.

19. Draw the structures of the following: (6%)
(a) $H_2S_2O_7$ (b) $H_2S_2O_8$ (c) $N(SiH_3)_3$ (d) P_4S_{10}
(e) B_2H_6 (f) B_4H_{10}.

20. Write the major product(s) for the following reactions: (6%)
(a) $CuS_{(s)} + HNO_3\,(conc.) \longrightarrow$
(b) $B_2H_6 + NH_3 \xrightarrow{\Delta}$
(c) $XeF_6 + H_2O \longrightarrow$