

1. Write the chemical formula for each of the following: (6%)

- (a) magnesium hydroxide (b) hexaborane (10)
(c) tetraaquodibromochromium(III) nitrate.

2. Determine the point group of the following: (8%)

- (a) CH_2Cl_2 (b) CH_2BrCl (c) I_3^+ (d) BrCl_3
(e) NSF_3 (f) B_2H_6 (g) $\text{Ni}(\text{CN})_4^{2-}$ (h) NiCl_4^{2-}

3. Find organic fragments isolobal with each of the following: (6%)

- (a) $\text{Mn}(\text{CO})_5$ (b) $\text{Co}(\text{CO})_4$ (c) $\text{Ni}(\text{CO})_3$

4. Explain the following terms: (12%)

- (a) Zeeman effect (b) Russell-Saunders coupling
(c) Cotton effect

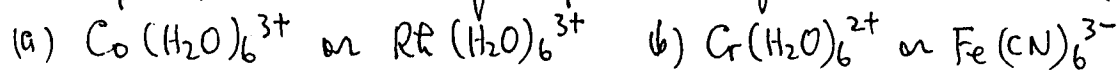
5. Choose and explain: (16%)

- (a) Higher ionization energy: Be or B
(b) Higher electron affinity: O or S
(c) Stronger reducing agent: Mg or Sr
(d) Strongest base to BMe_3 : pyridine, 2-methylpyridine, or 4-methylpyridine.

6. Predict the number of unpaired electrons for each of the following: (6%)

- (a) A square planar d^7 ion.
(b) $\text{Co}(\text{CN})_6^{3-}$.
(c) A coordination compound with a magnetic moment of 5.1 Bohr magnetons.

7. Which complex ion has the larger crystal field splitting in each pair? Give a brief explanation for each answer. (4%)



8. Explain each of the following: (30%)

(a) The acid strength in the oxo-acids of chlorine is $\text{HClO}_4 > \text{HClO}_3 > \text{HClO}_2 > \text{HClO}$.

(b) BCl_3 is a better electron acceptor than BF_3 .

(c) Trisilylamine, $(\text{SiH}_3)_3\text{N}$, is planar and is a very weak base.

(d) Borazine ($\text{B}_3\text{N}_3\text{H}_6$) undergoes addition reaction much more easily than does benzene.

(e) The Mn-O distance in MnO_4^{2-} is longer (by 3.9 pm) than in MnO_4^- .

(f) The optical absorption bands due to d-d transition in transition metal compounds are broad.

9. The high-spin d^4 complex $\text{Cr}(\text{H}_2\text{O})_6^{2+}$ is labile, but the low-spin d^4 complex ion $\text{Cr}(\text{CN})_6^{4-}$ is inert. Explain. (6%)

10. Of the compounds $\text{Cr}(\text{CO})_5(\text{PF}_3)$ and $\text{Cr}(\text{CO})_5(\text{PCl}_3)$, which would you expect to have:

(a) The shorter C-O bonds?

(b) The higher-energy Cr-C stretching bands in the IR spectrum?

Explain your answers. (6%)