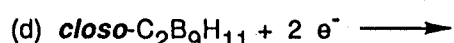
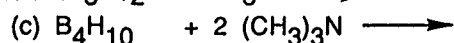
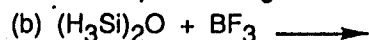
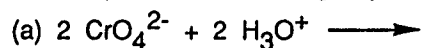


1. On the basis of inductive effect, the Lewis acidity of the boron halides is expected to be $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3$. Experimentally, the opposite is observed. Explain these apparent anomaly (5%).

2. Complete the following equations: (8%)



3. Explain the following: (12%)

(a) Borazines undergo addition reactions much more easily than does benzene.

(b) The optical absorption bands of lanthanide compounds are much narrower than those of transition complexes.

(c) Trisilylamine, $(\text{H}_3\text{Si})_3\text{N}$, is a very weak base.

(d) Si_2H_6 is more chemically reactive than does C_2H_6 .

4. Use the Valence Bond theory to predict the structure of NO_2 , NO_2^+ , and NO_2^- (including the assignment of lone-paired electrons) (6%).

5. The melting point of following compounds shown as below:

KBr, 730°C ; CsF, 684°C ; CaBr₂, 765°C ; BaF₂, 1280°C

Explain the trend of changing (4%).

6. Predict the trend of IR stretching frequency of C=O in the following compounds and explain: (4%)

(a) cyclobutanone (b) cyclopentanone (c) cyclohexanone

7. Give the ground-state term symbol of Cr^{3+} , Mg, and C with consideration of the spin-orbit coupling effect (6%).

8. Use Slater's rule and Clementi & Raimondi Equation to evaluate the effective nuclear charge (Z^*) for a 2s-electron of Br atom, respectively. Explain the difference between the two values of Z^* (5%).

[Clementi & Raimondi Equation of shielding factor:

$$S_{2s} = 1.7208 + 0.3601 (N_{2s} - 1 + N_{2p}) + 0.2062 (N_{3s,p,d} + N_{4s,p})]$$

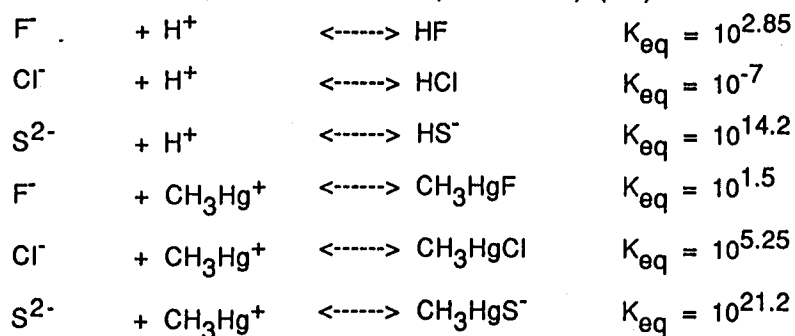
9. Tell the difference between lability and instability of a compound (3%).

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10. Give possible structures of $[\text{Pt}(\text{NH}_3)_2(\text{py})_2\text{Cl}_2]^{2+}$ (3%).

11. From the view points of Valence Bond Theory and Molecular Orbital Theory, what would make CO a very strong ligand? (8%)

12. Using the following data, illustrate what kind of relationship exists between the acid-base strength and hardness (or softness) (5%).



13. The ground state for a d^1 species is 2D . What states will 2D be split into if a d^1 species is under the influence of a tetrahedral field? What electronic configurations will correspond to each split state? How many microstates does each split state contain? (6%)

14. Draw structures for (a) π -allylmolybdenum (b) $\text{Os}_3(\text{CO})_{10}(\mu_2\text{-CH}_2)(\mu_2\text{-CO})$ (c) Metalacyclobutane (6%).

15. Explain the following questions:

(a) β -Elimination cannot happen for $\text{Cr}(\text{CHMe}_2)_4$ although this compound has β -hydrogen atoms (3%).

(b) The reaction between $(\eta^5\text{-C}_5\text{Me}_5)_2\text{Zr}(\text{Me})_2$ and CO does not give the expected product, $(\eta^5\text{-C}_5\text{Me}_5)_2\text{Zr}(\text{Me})(\eta^1\text{-acyl})$ but $(\eta^5\text{-C}_5\text{Me}_5)_2\text{Zr}(\text{Me})(\eta^2\text{-acyl})$ (3%).

(c) $\text{W}(\text{CO})(\text{PhC}_2\text{Ph})_3$ is an eighteen-electron compound although each diphenylacetylene can donate four electrons to the tungsten atom (2%).

(d) $\text{L}_2\text{TiCl}_3(\text{CH}_2\text{CH}_3)$ (L is a phosphorus ligand) contains an agostic ethyl group; this group is stable with respect to β -elimination (3%).

16. Give the electron counts for the following compounds: (8%)

(a) WMe_6 (b) $\text{Co}(\eta^5\text{-C}_5\text{H}_5)_2$ (c) $\text{Mn}(\text{CO})_5$ (d) $\text{Cr}(\text{NO})_4$.