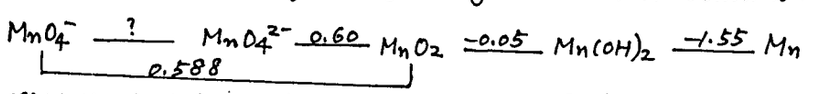
1. Write the electron configuration beyond a noble gas core for Tl and $Eu^{2+}$. ($_{54}Xe$, $_{63}Eu$, $_{81}Tl$). (6%)
2. Predict and draw the molecular structure by using the method of hybridization and also assign the point group for each of the following molecules:
   (a) $BrF_5$ (b) $SF_6$ (c) $PCl_3F_2$ ($_{15}P$, $_{35}Br$, $_{16}S$) (15%)
3. What is the expected bond order of the Se-Se bonds in the cyclic $Se_4^{2+}$ species? Why? (6%)
4. Select the most reasonable electron-dot structures of $SCN^-$ ion. Why? (4%)
   $:\ddot{S}-C\equiv N:^-$ , $:\ddot{S}=C=N:^-$ , $\ddot{S}=C=\ddot{N}^-$ , $:S\equiv C-\ddot{N}:^-$
5. Which one in each of the following pairs has the higher boiling point?
   (a) $CCl_4$, $NH_3$ ; (b) $H_2O$, $SiCl_4$ ; (c) LiI, LiF ; (d) Xe, $H_2$ (8%)
6. Explain why the nucleophilicity of $F^-$ ion in organic solvent like benzene is not as strong as it should have. How to improve it? (4%)
7. $CH_3CO_2H$ is a weak acid in water while it is a strong acid in $NH_3(\ell)$. Why? (4%)
8. Compare the electronegativity of the N orbital involved in the N-H bond for $NH_4^+$ and  . Why? (4%)
9. The electrical conductance of germanium is increased by a factor of $10^5$ when a few parts per million of arsenic are added. Explain it. (4%)
10. When dilute nitric acid reacts with Cu in a test tube, a colorless gas is formed that turns brown near the mouth of the tube. Explain the observations by writing the reactions involved. (6%)
11. The standard emf diagram of manganese in basic solution is given below:




   (a) Write the balanced half reactions for $MnO_4^{2-}/MnO_2$ and $Mn(OH)_2/MnO_2$ couples (6%)
   (b) Calculate $\mathcal{E}^\circ$ for $MnO_4^{2-}/MnO_4^-$ couple. (5%)
12. Why are low-spin complexes usually not found for tetrahedral coordination? (4%)
13. Which of the following complexes do you expect to be labile and which inert? Why?
   (a) $V(H_2O)_6^{3+}$ (b) $Co(CN)_6^{3-}$ ($_{23}V$, $_{27}Co$). (8%)
14. The complex $[Pt(NH_3)_2(NO_3)_2]$ has an $\alpha$-form and a $\beta$-form. The $\alpha$-form reacts with oxalic acid to give $[Pt(NH_3)_2(C_2O_4)]$ but the $\beta$-form gives $[Pt(NH_3)_2(C_2O_4H)_2]$ with oxalic acid. Explain it. (6%)
15. Give the formula of the most stable compound of the type Mn(olefin)(CO)$_x$ with olefin = $C_3H_5^-$ or $C_6H_6$. ($_{25}Mn$). (6%)
16. How to distinguish between $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$. (4%)