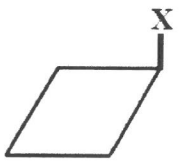
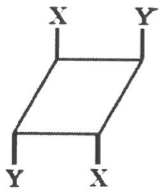
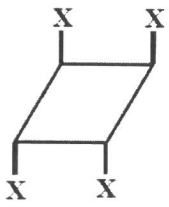
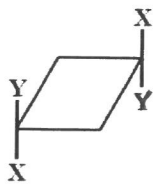
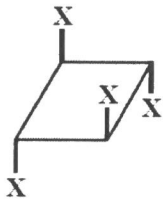
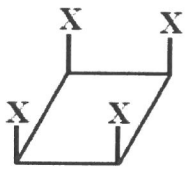
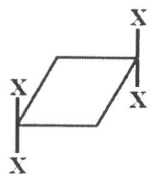
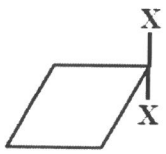
國立臺灣師範大學112學年度碩士班招生考試試題

科目：無機化學　　適用系所：化學系

注意：1.本試題共2頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則依規定扣分。

1. Please assign the point group for the following compounds (8*2 = 16 points)

(a)	(b)	(c)	(d)
			
(e)	**(f)**	**(g)**	**(h)**
			

2. All natural diamonds contain the defects made by nitrogen atoms. Clusters of N atoms are present in Type 1a diamonds (the most common defect structure), while Type 1b diamonds contain well-separated N atoms.
   (a) What kind of chemical bonding pattern could be seen for these nitrogen defects? (3 points)
   (b) Can N occupy the tetrahedral or octahedral holes in the diamond structures? Why? (6 points)
   (c) Please draw the density of state (DOS) diagram and the position of Fermi level for the perfect (no defects) diamonds , type 1a diamonds, and type 1b diamonds. (3*5 = 15 points)

3. Describe the chemical bonding of molecular oxygen using Valence Bond Theory and Molecular Orbital Theory. (10 points)

4. Draw the molecular structure of $Ni(CO)_4$ and $(\eta^3\text{-}C_5H_5)(\eta^5\text{-}C_5H_5)Fe(CO)$. (10 points)

5. What kind of electron transfer reaction will occur in the following pairs of reactants, and why? (10 points)
   (a) $[Co(NH_3)_5(H_2O)]^{3+} + [Cr(H_2O)_6]^{2+}$ (b) $[Co(NH_3)_5Cl]^{2+} + [Cr(H_2O)_6]^{2+}$

6. Determine the valence electron counts around the transition metal in the following complexes. (a) $V(CO)_6$ (b) $(\eta^3\text{-}C_3H_5)_2Ni$ (10 points)

7. Predict the products of the following reaction. (10 points)
   $[Mn(CO)_5]^- + H_2C{=}CHCH_2Cl \rightarrow$ initial <u>product (a)</u> $\rightarrow CO +$ final <u>product (b)</u>

8. (a) Write down the number of the unpaired electron(s) in $[Co(CO)_6](OTf)_2$, and (b) explain your answer in detail using the molecular orbital diagram of the complex. (10 points)