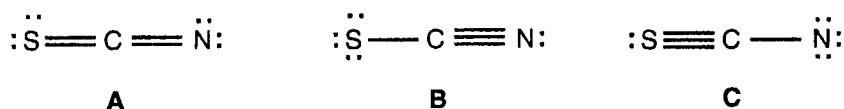
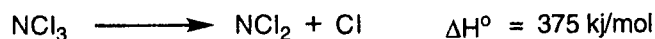
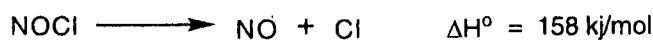


(1) (6%) The resonance structures of thiocyanate ion, SCN^- , are shown below. Assign formal charges for each of the structures. Which one is the most important structure of the ion? Explain.



(2) (6%) The energy required to break a particular bond is not always constant. Compare the N-Cl bond energies in NOCl and NCl_3 :



Why is there such a great discrepancy in the apparent N-Cl bond energies?

(3) Answer the following: (30%)

(a) The order of reducing abilities in aqueous solution is $\text{Li} > \text{K} > \text{Na}$, which is not the order expected from the relative ionization energies of these metals. Explain your answer.

(b) Predict the most likely structure of PCl_2F_3 and explain your reasoning.

(c) Square planar d^8 paramagnetic complexes are extremely rare. Account for this observation with a crystal field argument.

(d) Many complexes exhibiting charge transfer bands in the visible region are unstable in sunlight. Explain.

(e) The high-spin d^4 complex cation $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ is labile, but the low-spin d^4 complex anion $[\text{Cr}(\text{CN})_6]^{4-}$ is inert. Explain.

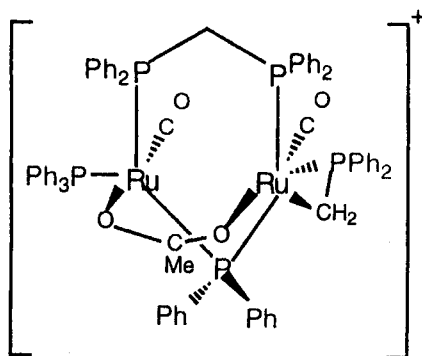
(4) (8%) Determine the number of IR active CO stretching modes for *trans*- $[\text{Fe}(\text{CO})_4\text{Cl}_2]$.

D_{4h}	E	$2C_4$	C_2	$2C_2'$	$2C_2''$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$		
A_{1g}	1	1	1	1	1	1	1	1	1	1	R_g	$x^2 + y^2, z^2$
A_{2g}	1	1	1	-1	-1	1	1	1	-1	-1		$x^2 - y^2$
B_{1g}	1	-1	1	1	-1	1	-1	1	1	-1	(R_x, R_y)	xy
B_{2g}	1	-1	1	-1	1	1	-1	1	-1	1		(xz, yz)
E_g	2	0	-2	0	0	2	0	-2	0	0	I	
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1		
A_{2u}	1	1	1	-1	-1	-1	-1	-1	1	1		
B_{1u}	1	-1	1	1	-1	-1	1	-1	1	-1		
B_{2u}	1	-1	1	-1	1	-1	1	-1	-1	1		
E_u	2	0	-2	0	0	-2	0	2	0	0	(x, y)	

(背面仍有題目,請繼續作答)

(5) (a) Sketch all the Schlenk glassware required on a laboratory bench for a simple filtration to obtain the solid precipitate from a reaction solution. The solid is air-sensitive. (6%) (b) Sketch a glove box and a glove bag, which can help synthesis and reactions of various air-sensitive compounds (4%).

(6) Give the electron count for each ruthenium atom in the following complex (4%), having recently been prepared in one laboratory at the department of chemistry, national Cheng Kung University, and explain why this complex is diamagnetic. (2%) Is it a chiral (or optically active) compound (2%)? How many IR active CO stretching bands should be observed in this complex (1%)? Give one reason to your prediction without referring to Group theory or using a Character Table (1%).



(7) (a) The anion $[\text{Ni}_2\text{Cl}_8]^{2-}$ belongs to the C_{2h} point group. Each nickel has a square pyramidal arrangement of ligands, and there are no Ni-Ni bonds. Sketch the structure (3%). (b) Describe and sketch simple structures for (i) tetragonal (Jahn-Teller) distortion, (ii) Trigonal distortion, and (iii) Twist distortion of an idealized octahedral complex $[\text{ML}_6]$ (9%).

(8) (a) Write the electron configuration of the N_2 and O_2 molecules (2%) and calculate the bond order for each molecule (2%). Compare the N-N or O-O bond lengths: which one is shorter (2%). (b) Why is O_2 more chemically reactive than N_2 ? (2%)

(9) It is not the *trans*- $[\text{PtCl}_2(\text{NH}_3)_2]$ but *cis*- $[\text{PtCl}_2(\text{NH}_3)_2]$ as the active antitumor reagent. Both chloride anions, rather than the NH_3 ligands, of this complex are known to be displaced during the antitumor process. When the NH_3 is replaced by a phosphorus compound, the activity is sharply dropped down. It is also found that the activity is $\text{cis-}[\text{PtCl}_2(\text{NH}_3)_2] < \text{cis-}[\text{PtCl}_2(\text{RNH}_2)_2] < \text{cis-}[\text{PtCl}_2(\text{R}_2\text{NH})_2] < \text{cis-}[\text{PtCl}_2(\text{NR}_3)_2]$. Explain why the active isomer is *cis*- $[\text{PtCl}_2(\text{NH}_3)_2]$ but not *trans*- $[\text{PtCl}_2(\text{NH}_3)_2]$ (4%) and explain the reduced activity in other substituted complexes such as *cis*- $[\text{PtCl}_2(\text{NR}_3)_2]$ (6%).