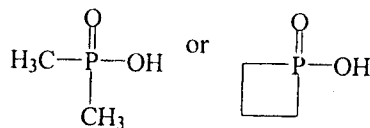


1. (12%) What is the point group of the following molecules:
 (a) NOCl (nitrosyl chloride) (b) C₆₀ (c) PFCl₄ (d) [Co(phen)₃]²⁺ (e) SF₄ (f) S₈
2. (8%) Determine the irreducible representation of each of the fundamental vibrations of *trans*-[PtCl₂Br₂]²⁻ (a square planar structure). And determine which are IR active, and which are Raman active?

D _{2h}	E	C ₂ (z)	C ₂ (y)	C ₂ (x)	i	σ(xy)	σ(xz)	σ(yz)		
A _g	1	1	1	1	1	1	1	1		x ² , y ² , z ²
B _{1g}	1	1	-1	-1	1	1	-1	-1	R _z	xy
B _{2g}	1	-1	1	-1	1	-1	1	-1	R _y	xz
B _{3g}	1	-1	-1	1	1	-1	-1	1	R _x	yz
A _u	1	1	1	1	-1	-1	-1	-1		
B _{1u}	1	1	-1	-1	-1	-1	1	1		z
B _{2u}	1	-1	1	-1	-1	1	-1	1		y
B _{3u}	1	-1	-1	1	-1	1	1	-1		x

3. (5%) Show your understanding of the meaning of the Madelung constant by calculating *A* for the isolated F⁻ Be²⁺ F⁻ fragment considered as a purely ionic species.
4. (10%) Use molecular orbital theory to predict the bond order and the number of unpaired electrons in
 (a) C₂ (b) O₂²⁻
5. (20%) Select the better choice in each of the following, and explain your selection briefly.
 (a) Which has the higher first ionization energy? Sc or Cu?
 (b) Which has the higher electron affinity? F or PtF₆
 (c) Which is stronger Lewis acid?



- (d) Which complex is paramagnetic? [NiCl₄]²⁻ or [PtCl₄]²⁻
 (e) Which compound has higher IR-active CO stretching frequency?
 [Mn(CO)₆]⁺ or [V(CO)₆]⁻

(背面仍有題目,請繼續作答)

6. 10% Determine the number of unpaired electrons, and calculate the magnetic moment for the spin-only contribution and LFSE for each of the following:
(a) $[\text{Fe}(\text{CN})_6]^{3-}$ (b) $[\text{CoCl}_4]^{2-}$
7. 5% For complexes of Fe^{3+} and Ag^+ with SCN^- , would you expect coordination of SCN^- through S or N to these cations? Explain your answer briefly.
8. 10% The ^1H NMR spectrum of $(\text{C}_5\text{H}_5)_2\text{Fe}(\text{CO})_2$ shows only a single peak at room temperature but gives four resonances of relative intensity 5:2:2:1 at low temperature. Explain.
9. 8% Predict the metal-metal bond order consistent with 18-electron rule for neutral complexes having the formula $[(\text{OC})_4\text{M}(\mu\text{-PR}_2)_2\text{M}(\text{CO})_4]$ where $\text{M} = \text{V}$ and Mn .
10. 12% Explain the following items.
(a) Jahn-Teller distortion
(b) Meissner effect
(c) Ferromagnetic interaction
(d) Δ and Λ absolute configuration of $[\text{Co}(\text{en})_3]^{3+}$