科目：無機化學(1003)

校系所組：中央大學化學學系
交通大學應用化學系（甲組）
清華大學化學系
清華大學材料科學工程學系（丙組）

1. What are the differences between lithophiles and chalcophiles elements found in the crust of the Earth (5 points)

2. At most, how many electrons in an atom can have both n = 5 and l = 3 ? (5 points)

3. X-ray crystal structures of ClF_3O and BrF_3O have been determined.

(a) Would you expect the lone pair on the central halogen to be axial or equatorial in these molecules? Why? (5 points) (Draw the Lewis structure will be helpful)

(b) Which molecule would you predict to have the smaller $F_{equatorial}$-central atom-oxygen angle? Why? (5 points)

4. Using the character table shown below, constructing the molecular orbital of NH_3 (please write the construction process as detail as possible) (10 points)

C_{3v}	E	$2C_3$	$3\sigma_{v)}$		
A_1	1	1	1	z	x^2+y^2, z^2
A_2	1	1	-1	R_z	xy
E	2	-1	0	(x, y) (Rx, R_y)	(x^2-y^2, xy) (xz, yz)
I		II		III	IV

5. HF has H_o = -11.0 (H_o: Hammett acidity function). Addition of 4 % SbF_5 lowers H_o to 21.0, which is acidic enough to protonate alkene. Explain why? (5 points)

6. What is "p-n junction"? Give two applications of "p-n junction" and simply describe their working principle. (10 points, 2 points for each answer)

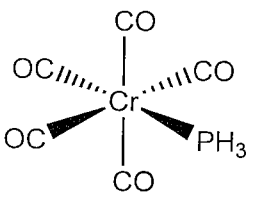
注意：背面有試題

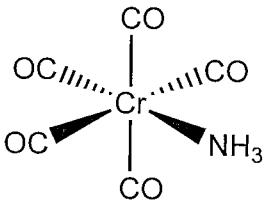
科目：無機化學(1003)

校系所組：中央大學化學學系
交通大學應用化學系（甲組）
清華大學化學系
清華大學材料科學工程學系（丙組）

7. Although B_2H_6 has D_{2h} symmetry. I_2Cl_6 is planar. Draw the Lewis structures of these two molecules. (5 points)

8. Calculations have been reported on the changes that occur when the following compounds are oxidized by one electron. (10 points)

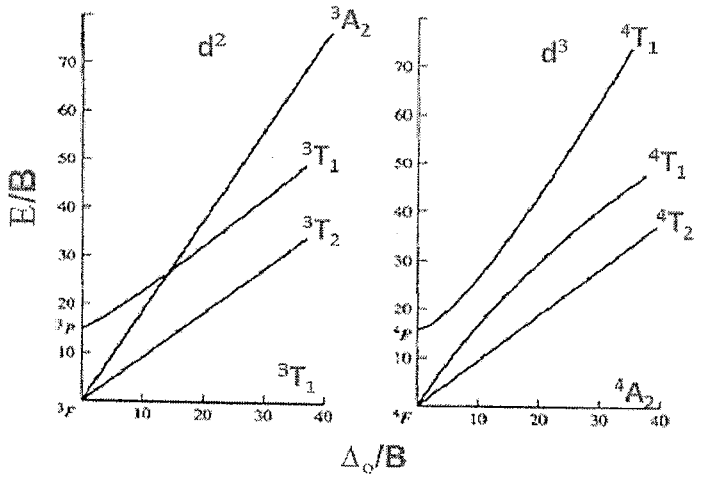




(a) What is the effect on the C-O distances when they are oxidized? Why?

(b) What is the effect on the Cr-P and Cr-N when they are oxidized? Why?

9. From the following spectral data and using the Tanabe-Sugano diagrams (shown below), calculate Δ_o (and B) for the following:



(a) $[Cr(C_2O_4)_3]^{3-}$, which has absorption bands at 23600 and 17400 cm^{-1}. A third band occurs well into the ultraviolet. Calculate Δ_o. (2 points)

(b) $[VF_6]^{3-}$, which has absorption bands at 14800 and 23250 cm^{-1}, plus a third band in the ultraviolet. Calculate Δ_o. **Also calculate B** for this ion. (8 points)

注意：背面有試題

科目：無機化學(1003)

校系所組：中央大學化學學系
交通大學應用化學系（甲組）
清華大學化學系
清華大學材料科學工程學系（丙組）

10. Complexes of formula Rh(CO)(phosphine)$_2$Cl have the C-O stretching bands shown below. Match the infrared bands with the appropriate complex and explain why? (11 points)

ν(CO), cm^{-1}: 1923, 1984, 2004;

Complex: Rh(CO)(**P(p-C$_6$H$_4$F)$_3$**)$_2$Cl, Rh(CO)(**P(t-C$_4$H$_9$)$_3$**)$_2$Cl, Rh(CO)(**P(C$_6$F$_5$)$_3$**)$_2$Cl.

11. Predict the transition metal-containing products of the following reactions: (3 points each),

(a) $Ir(PPh_3)_3Cl \xrightarrow{\Delta}$

(b) *trans*-$Ir(CO)Cl(PPh_3)_2 + H_2 \longrightarrow$

(c) $W(CO)_6 + C_6H_5Li \longrightarrow$

12. List 4 Greenhouse gases (8 points). Explain why one of them is more notable (2 points).