

國立臺灣師範大學 113 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 3 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。

I. Cloze Test: Read each paragraph and match a correct answer from the table. (12 points)

A_1	antiferromagnetic	charge	de Broglie equation	diamagnetic
E	ferromagnetic	multiplicity	oxidation numbers	paired electrons
paramagnetic	repulsion	Schrödinger equation.	symmetry	uncertainty

- The energy of a nonbonding orbital is essentially that of an atomic orbital, either because the orbital on one atom has a symmetry that does not match any orbitals on the other atom or the orbital on one atom has a severe energy mismatch with _____-compatible orbitals on the other atom.
- Electrons moving in circles around the nucleus, as in Bohr's theory, can be thought of as standing waves that can be described by the _____.
- Hund's rule of maximum _____ requires that electrons be placed in orbitals to give the maximum total spin possible.
- Formal charge is the apparent electronic _____ of each atom in a molecule based on the electron-dot structure.
- _____ compounds are attracted by an external magnetic field. This attraction results from one or more unpaired electrons behaving as tiny magnets.
- The s and p_z orbitals of nitrogen in ammonia both have _____ symmetry in the C_{3v} point group.

C_{3v}	E	$2C_3$	$3\sigma_v$		
Γ	3	0	1		
A_1	1	1	1	z	$x^2 + y^2, z^2$
E	2	-1	0	$(x, y), (R_x, R_y)$	$(x^2 - y^2, xy), (xz, yz)$

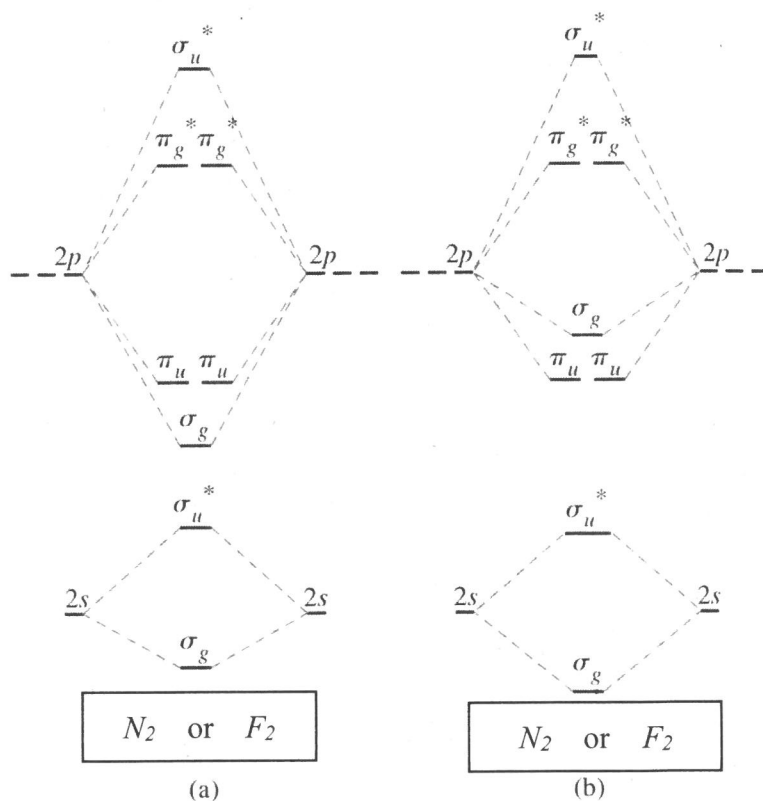
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II. Draw the chemical structure and determine the point groups for the following compounds. *The structures must be correct to receive the point group credits. (24 points)*

- (a) Cyclohexane (chair conformation)
- (b) Diborane
- (c) H_3O^+
- (d) O_2F_2
- (e) S_8 (puckered ring)
- (f) Borazine (planar)

III. MO diagrams of N_2 and F_2 are shown in either (a) or (b). (14 points)

1. **Fill** electrons into the MO diagrams and **name** the correct gas (N_2 or F_2).
2. Also, **draw** an O_2 MO diagram, **fill** in unpaired electrons, and **calculate** the bond order(s). *Total points are only possible after drawing the O_2 MO diagram to calculate the correct bond order(s). If not, no point will be received.*

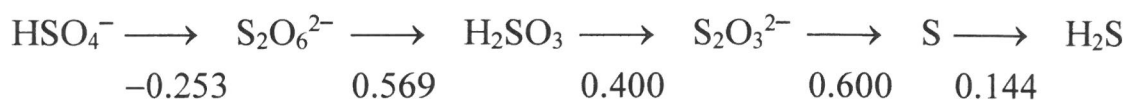


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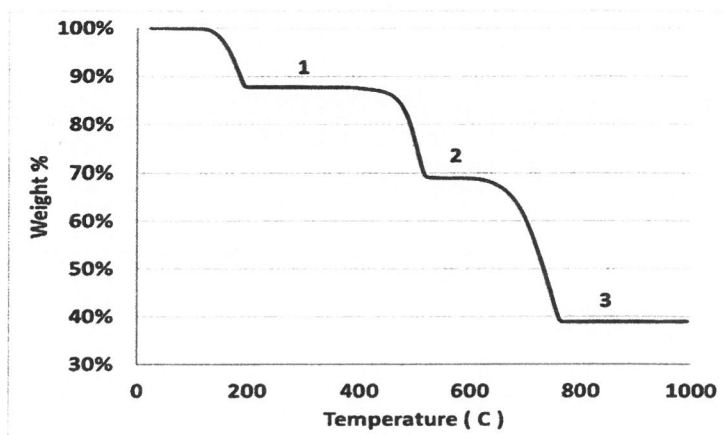
IV. Draw all of the possible isomers (DO NOT include optical isomers) of the following complexes and assign the point group to each isomer: (20 points)

- (a) $\text{Pd}(\text{NH}_3)_2\text{Br}_2$
- (b) $\text{Cr}(\text{P}(\text{CH}_3)_3)_3\text{Cl}_3$
- (c) $\text{Ru}(\text{bpy})_2(\text{SCN})_2$ bpy: bipyridine
- (d) $\text{Co}(\text{NH}_3)_4\text{Cl}_2$
- (e) $\text{Fe}(\text{NH}_3)_2\text{Cl}_2(\text{NO}_2)_2$

V. The Latimer diagram for sulfur in acidic solution is shown below. Determine the reduction potential for $\text{S}_2\text{O}_6^{2-}$ to $\text{S}_2\text{O}_3^{2-}$. Write a balanced equation for this half-reaction. (10 points)



VI. The TGA analysis of $\text{CaOx} \cdot n\text{H}_2\text{O}$, crystal A, is shown below, where Ox is $\text{C}_2\text{O}_4^{2-}$ and n is an integer. (Ca:40, C:12, O:16) (20 points)



- (a) Write down the chemical formula of compound A, and compounds 1, 2, 3 as shown on above chart.
- (b) Write the balance equations for the reactions that taking place at 500 and 750°C.