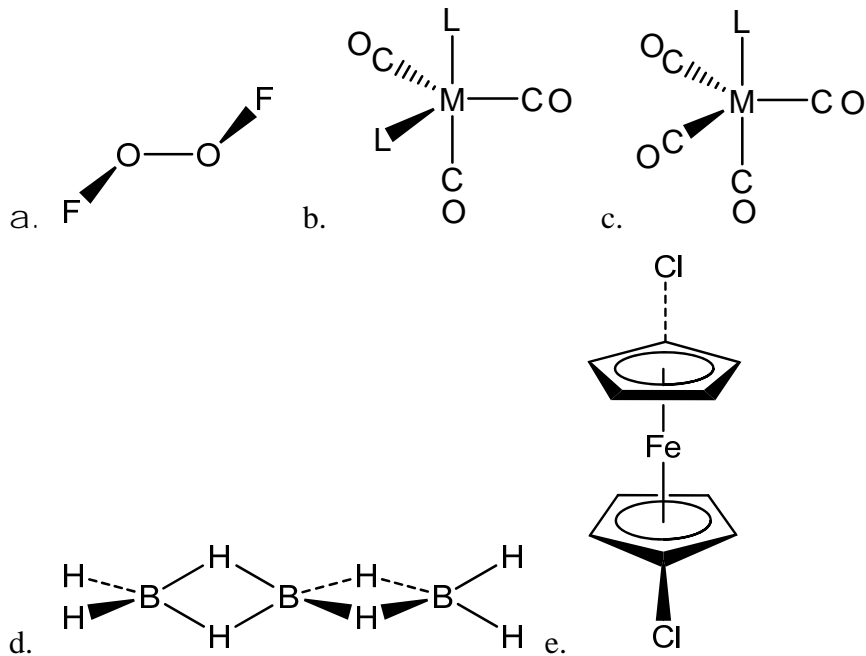


綜合化學（無機）

- Determine the ground terms for the following configurations: (5%)
 - d^8 (O_h symmetry)
 - d^4 (T_d symmetry)
- An aqueous solution of $Ni(NO_3)_2$ is green. Addition of aqueous NH_3 causes the color of the solution to change to blue. If ethylenediamine is added to the green solution, the color changes to violet. Account for the colors of these complexes. Are they consistent with the expected positions of these ligands in the spectrochemical series? (10%)
- Determine the point groups for following compounds. (10%)



綜合化學（物化）：

Explain or define the following terms (2.5 point each).

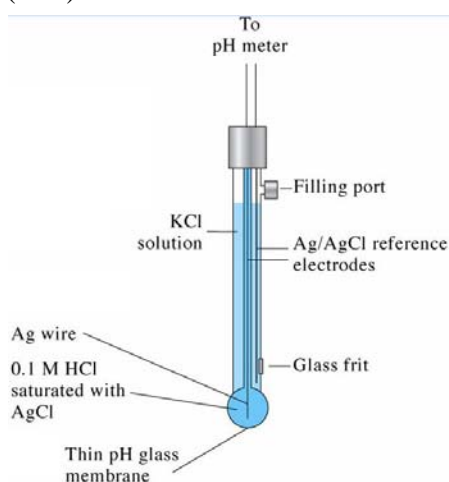
- The first law of thermodynamics
- State function
- Joule coefficient
- Carnot cycle
- Gibbs-Helmholtz equation
- Colligative properties
- Phosphorescence
- Mean free path
- Steady-state approximation
- Michaelis-menten mechanism

綜合化學（分析）：

Free response (25%)

- Define the following concentration units:
 - molarity (M), b) molality (m), c) ppm, d) ppb, e) wt%. (10 %)

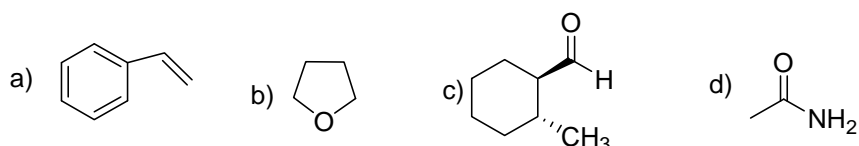
2. Imagining that you are in a laboratory and asked to prepare a 50 mL 0.5 M NaCl (NaCl: 58 g/mol) aqueous solution. You have an electronic analytical balance, a 50 mL-volumetric flask, and other necessary tools. Please describe your procedures in detail. (5 %)
3. The following plot shows a pH-sensitive glass membrane electrode. If you are going to use this electrode to measure the solution pH, should the glass frit be placed above or below the interface of the solution? (2 %) Why is a glass frit necessary? (3 %)



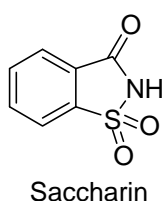
4. Please differentiate between an *excitation* spectrum and an *emission* spectrum in fluorescence spectroscopy. (5 %)

綜合化學（有機）：

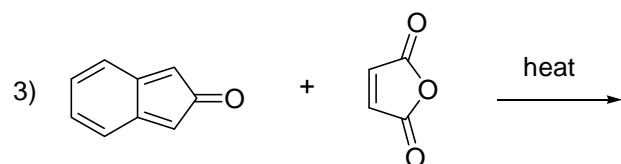
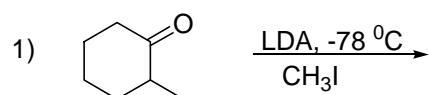
1. give the systematic name for each of the following compounds. (8 %)



2. Saccharin, an artificial sweetener, is about 300 times sweeter than sucrose. Describe how Saccharin could be prepared, using benzene as the starting material. (6 %)



3. Complete the following reactions: (6 %)



4. Propose a mechanism for the following reaction: (5 %)

