1. Explain the following terms:
   (1) State function? (何謂狀態函數?)
   (2) The van der Waal's equation for real gases? (何謂凡得瓦爾真實氣體方程式? 修正了那些項目?)
   (3) Heisenberg “Uncertainty Principle”? (何謂海森堡的測不準原理?)
   (4) Hydrogen bonding? Give an example. (何謂氫鍵? 試舉例說明)
   (5) Bond Energy? (何謂鍵能?)

2. A star is estimated to have a mass of $2.0 \times 10^{36}$ kg. Assuming it to be a sphere of average diameter $1.4 \times 10^6$ km, calculate the average density of the star in units of grams per liter (g/L)?

3. Calculate $\Delta H$ for each of the following reactions in the gas phase. (使用鍵能計算下列反應式的反應熱?)
   (1) $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$  $\Delta H = ?$ kJ
   (2) $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$  $\Delta H = ?$ kJ
   Bond energy: $E_\text{b}(\text{H}-\text{H}) = 432$ kJ/mol, $E_\text{b}(\text{Cl}-\text{Cl}) = 239$ kJ/mol, $E_\text{b}(\text{H}-\text{Cl}) = 427$ kJ/mol
   $E_\text{b}(\text{N}-\text{H}) = 391$ kJ/mol, $E_\text{b}(\text{N}=\text{N}) = 941$ kJ/mol.

4. (1) What is the symbol ($^{4}_2\text{X}$) for an atom with atomic number = 9 and mass number = 19?
   (2) What is the symbol ($^{\text{A}}_{\text{Z}}\text{X}^{\text{n}}$) for an ion with 17 protons, 18 electrons, and 20 neutrons?
   (3) What is the symbol ($^{\text{A}}_{\text{Z}}\text{X}^{\text{n}}$) for an ion with 50 protons, 68 neutrons, and 48 electrons?

5. Write the Lewis structure and predict the geometric structure of the following molecule or ion.
   (分別写出下列各分子或離子的 (a) 路易士構造, 與其 (b) 幾何形狀?)
   (1) $\text{ClF}_3$  (2) $\text{XeO}_3$  (3) $\text{PCl}_4^+$  (4) $\text{XeF}_4$  (5) $\text{IF}_5$

6. Consider the reaction between 50.0 mL of liquid methyl alcohol, CH$_3$OH (density = 0.856 g/mL), and 22.8 L of O$_2$ at 27°C and a pressure of 2.00 atm. The products of the reaction are CO$_2$ (g) and H$_2$O(g). Calculate the number of moles of H$_2$O formed if the reaction goes to completion. (CH$_3$OH : 32.04 g/mole)

7. To determine the molar mass of a certain protein, 0.250 g of it was dissolved in enough water to make 100 mL of solution. The osmotic pressure of this solution was found to be 2.80 torr at 25.0°C. Calculate the molar mass of the protein? (將 0.250 g 蛋白質加水溶成 100 mL 水溶液, 在 25.0°C 下測得其滲透壓為 2.80 torr, 試計算此蛋白質的分子量?)