1. A soil has a compression index of 0.31. Its void ratio at an effective vertical stress of 125 kN/m² is 1.04, and its permeability is $4 \times 10^{-7}$ mm/sec.

(1) Compute the change in void ratio if the soil stress is increased to 187 kN/m².

(2) Compute the settlement if the soil stratum is 5 m thick with double drainage.

(3) Find the time required for 25%, 50%, 70% and 90% of primary consolidation settlement to occur. (20%)

2. A silty sand has a consolidated-undrained friction angle of 22° and a drained friction angle of 32°.

(1) If a consolidated-drained test on such a soil is conducted at a chamber confining pressure of 180 kN/m², what will be the major principal stress at failure?

(2) If a consolidated-undrained test is conducted at the same chamber pressure, calculate the pore pressure that will be generated in the soil sample at failure. (15%)

3. In calculating the limit load formula of a foundation, one of the terms is the foundation width, B, in a cubic expression, such as:

$$q_u = cN_e + qN_q + \frac{1}{2} \gamma B^2$$

(1) Please explain which parameter in soil has a direct relationship (10%).

(2) This relationship is related to soil which property (10%).

(3) If $q_u$ increases with B, in a uniform and depth unlimited soil, a foundation limit load in the same situation, will its settlement also increase with B? Please discuss the characteristics of sand and clay soil in this situation (15%).
4. 如圖下中所示之懸臂式擋土牆

(1) 請根據 Rankine 的理論畫出擋土牆後之土壓力分佈圖 (標註底部之土壓力)。請明示其合力的大小、方向、作用位置。(10%)

(2) 請分析此擋土牆之穩定性，求出個別之安全係數。混凝土單位重為 30 kN/m^3。(6%)
   a. 傾倒
   b. 滑動

(3) 請說明當擋土牆在以下狀況時，設計上應該如何修正或有其他方法以克服問題：(3%)
   a. 承載力不符合要求
   b. 抗滑動安全係數不符合要求
   c. 抗傾倒安全係數不符合要求

(4) 請設計擋土牆的排水工，請繪圖並說明之。(3%)

5. 如下圖所示之中開挖挖土結構，

(1) 計算抗隆起(Bottom Heave)之安全係數。(6%)

(2) 當抗隆起安全係數不足時，設計上可以如何修正？(2%)
T_{ext} = 18 \text{ kN/m}^2
\gamma = 60 \text{ kPa}