

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (1) What is the specific speed (or called type number) of centrifugal pumps? Also explain how specific speed can be used to guide pump selection for various applications, which cover various combinations of flow rate and total dynamic head?
(2) Manufacturer's data for a centrifugal pump indicate that the pump can discharge $0.3 \text{ m}^3/\text{s}$ at a head of 34.4 m when the impeller speed is 1170 rpm. What is the expected pump discharge and head if the impeller speed is reduced to 870 rpm? (20%)
2. Define **time of concentration** of a drainage basin when design a storm sewer system. How is it determined, and what is it used for? (10%)
3. Specify and explain the most important parameter for the design of the following water treatment units: (1) sedimentation tank, (2) flocculation tank, (3) granular activated carbon bed, (4) chlorine contact basin. (20%)
4. (1) The daily waste-activated sludge from a secondary wastewater treatment plant contains 600 kg of dry solids and has a solids content of 1.2 percent. Assume the organic content of total solids is 60 percent, while the specific gravity of the volatile and fixed solids is 1.0 and 2.5, respectively. After thickening, the solids content is increased to 3.0 percent. Calculate the volume of sludge that must be processed after thickening, and the percent of volume reduction in the thickener. (Assume the water density is $1,000 \text{ kg/m}^3$)
(2) The thickened sludge above is processed in a standard-rate anaerobic digester. The digestion period is 30 d and the sludge must be stored for 45 d between final disposal events. During the digestion, 50 percent of the organics is converted to gaseous or liquid end products. The solids content of the digested sludge is 5.6 percent. Determine the required reactor volume and the volatile solids loading rate ($\text{kg/m}^3\text{-d}$). (20%)
5. Sketch the flow diagram of a conventional secondary municipal wastewater treatment plant. Assume activated sludge process is employed. Also give explanation for the function of each unit. (20%)
6. Explain how the **oxygen sag curve** is formed in stream self-purification. (10%)