1. There are 8 railroad stations along the high-speed train transportation system. At least 6 stations are built in the undeveloped area. So, four kinds of piping system should be designed and constructed to supply and to discharge water, electricity and natural gas for the resident people. Could you describe any creative approach about how to distribute or to collect these four kinds of fluid for public utilities in the new developing towns. (20%)

2. Qea-Zen high-speed railroad station (Tainan) will be developed to a new town with population up to 50,000 people. If the water supply and the sewage collection systems are 100% popular to every house. Could you calculate out the maximum amount of <u>tap water</u>, <u>sewage</u> and house-hold <u>garbage/kitchen waste</u> will be produced every day. You should assume the reasonable unit volume per capita per day.(15%)

3. Kao-Hsiung City's water supply is being treated with an advanced water purification system for improvement of safe drinking water quality. There are at least three new unit processes being constructed to remove microorganism, organic carbon and Ca^{2+} hardness. Please describe at least 3 types of new unit with the specific removal function. Detailed explanation is necessary.(15%)

4. Different types of <u>pump</u> are used in the sanitary engineering, please write out at least 5 types of the pump. The model, characteristic and application (usage) should be explained detailedly.(15%)

5. Right nowadays, the main sewer piping systems are under construction in every municipal city, Taiwan. Most of the main sewer employs tunneling work method in under ground soil. For example, the shield driving method should dig a manhole from the ground surface with a vertical <u>working well</u>, then the horizontal <u>sewer pipeline</u> should be drilled step by step. Please draw two figures of the cross section of sewer construction to describe the detail of sewer construction.(15%)

6. Gravity sedimentation tank is the most popular unit operation to settle down the particles such as sand or colloidal organics. Please explain the following problems ：

(1) terminal velocity.

$$V = \frac{D^2(\rho_s - \rho_l)}{18\ \mu} \times g \quad \text{for small fine particle}$$

$$V = \sqrt{[\frac{3(\rho_s - \rho_l)D}{\rho_l}] \times g} \quad \text{for big coarse particle}$$

(2) To draw a cross sectional structure of sedimentation tank shape with the detailed facilities or equipment.(20%)