國立成功大學

112學年度碩士班招生考試試題

編　號：141

系　所：環境工程學系

科　目：衛生工程

日　期：0206

節　次：第 1 節

備　註：可使用計算機

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※ 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. Answer the following questions or explain the terms.

(1) Identify one(s) of the Sustainable Development Goals (SDGs) that is/are directly related to water and wastewater treatment. (5%)

(2) For a negatively charged colloid in an electrolyte solution, please draw the distribution of electrolyte ions and the surface (electrostatic) potential changes from the colloid surface. Indicate the specific surface potentials introduced in class. (10%)

(3) Describe "crown corrosion" and lists at least two methods to minimize it. (5%)

(4) What are the benefits of using polymers in coagulation? (5%)

(5) Describe how pH affect disinfection efficiency using free chlorine and why. (5%)

2. Given a set of population data from 1950 to 1990 for a town as shown in the table below, (1) derive the population growth rate prediction equation using the geometric trend. (10%) (2) Derive the geometric progression rate constant, k_g. (5%) (3) Predict the population at the year of 2030 using both equations derived. Show all your work (i.e., tabulate your calculations) in order to receive full credits. (5%) (4) the data represent the population of a typical town in Taiwan, calculate the maximum daily consumption at 2030. Use the population at the year of 2030 estimated from the geometric progression equation. Assume a reasonable total consumption (lpcd) for this town. (5%)

Year	Population (x, 10^3 people)	Growth rate (y, %)
1950	42.0	26.7
1960	53.2	50.2
1970	79.9	23.8
1980	98.9	39.6
1990	138.0	18.8

3. A rapid mixing tank equipped with mechanical mixers will be used to mix the coagulant, alum, into water at 10°C ($\mu = 1.307 \times 10^{-3}$ N·s/m^2) in 10 sec with a mean velocity gradient of 800 s^{-1} for a flow of 10 mgd (mega gallon/day). 1 gallon = 3.785 L.

(1) Find the power of the mixer motor assuming it operates at 70% efficiency. (5%)

(2) The temperature increases to 25°C ($\mu = 0.89 \times 10^{-3}$ N·s/m^2). What is the velocity gradient at the same level of mixer power? Please comment on the temperature effect on coagulation. (5%)

4. A rectangular sedimentation basin will have a flow of 1.0 mgd (mega gallon/day) using a 2:1 length/width ratio, an overflow rate of 0.00077 fps (ft/sec) and a detention time of 3 hours. What is the dimension (length × width × height) (express in meter) of the sedimentation basin? 1 gallon = 3.785 L, 1 ft = 0.305 m (10%)

5. Calculate the head loss through a clean sand filter with a gradation as given by the sieve analysis below. The filtration rate is 2 L/m^2·s and the water temperature is 10°C. The filter depth is 0.61 m with a porosity of 0.4, the sand grains have a sphericity of 0.8, k = 5, $\nu = 1.306 \times 10^{-6}$ m^2/s. (15%)

Size of Opening (mm)	14	10	8	7	6	5	4	3
Fraction of sand retained	0	10	20	20	23	17	8	2

$$\frac{h}{L} = \frac{36k\nu}{g}\frac{(1-\varepsilon)^2 V}{\varepsilon^3 \psi^2}\sum_{i=1}^{n}\frac{Pi}{d_i^2}$$

6. To achieve a 4-log removal of pathogens with a reaction rate constant of 0.1 L/min·mg in raw water, what c·t value is required? (10%)