

99MIM002
國立臺北科技大學九十九學年度碩士班招生考試

系所組別：3210 環境工程與管理研究所甲組

第一節 環境工程 試題

第一頁 共一頁

注意事項：

1. 本試題共 10 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. (10 points, 5 for each) A water sample contains 10 mg NO₃⁻/L. What is the concentration in (a) ppm on a mass basis, and (b) moles/L?
2. (10 points) A pond is used to treat a dilute municipal wastewater before the liquid is discharged into a river. The inflow to the pond has a flow rate of $Q = 4,000 \text{ m}^3/\text{day}$ and a biochemical oxygen demand (BOD) concentration of $C_{in} = 25 \text{ mg/L}$. The volume of the pond is $20,000 \text{ m}^3$. The purpose of the pond is to allow time for the decay of BOD to occur before discharge into the environment. BOD decays in the pond with a first-order rate constant equal to 0.25/day. What is the BOD concentration at the outflow of the pond, in units of mg/L?
3. Consider the following reaction representing the combustion of propane:
$$\text{C}_3\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$$
 - a. (2 points) Balance the equation.
 - b. (2 points) How many moles of oxygen are required to burn 1 mole of propane?
 - c. (3 points) How many grams of oxygen are required to burn 100 g of propane?
 - d. (3 points) Under standard conditions (temperature of 25°C, pressure of 1 atmosphere, and oxygen concentration equal to 20% on a volume basis), what volume of air is required to burn 100 g of propane?
4. When you refuel at the gas station, a certain amount of energy is being transferred from the pump to your vehicle in a certain amount of time. Since energy per time is power, one can estimate the amount of power involved in refueling. For a reasonable estimate, consider that you pump 20 gallons in 3 minutes, that gasoline contains 45 MJ per kg, and that gasoline density is 0.68 kg per liter. (1 gallon = 3.785 liter)
 - a. (4 points) Estimate the power (in W, kW or MW) involved during refueling.
 - b. (3 points) Considering hydrogen as the fuel and given that the energy density of H₂ is 143 MJ/kg, how many kilograms of hydrogen make the equivalent of 20 gallons of gasoline?
 - c. (3 points) To which pressure should hydrogen be compressed to take the same volume? (Use ideal gas law and give answer in atmospheres.)
5. If the sky over county A were always cloud-free, the yearly average solar radiation would be 290 W/m². But, clouds exist and attenuate 47.4% of solar radiation that reaches the ground.
 - a. (5 points) If you want to generate from your building a yearly total of 15,000 kWh of electricity with photovoltaic cells that are 15% efficient and cost \$400/m², how much roof area do you need to cover and how much will it cost you?
 - b. (5 points) If you are able to sell this electricity to the power company at 12 cents per kWh, how long will it take you to repay your investment?
6. (10 points, 2 for each) Which of the following statements about a cyclone separator are true?
 - (a) The vortex inside the main chamber occurs without the aid of moving parts.
 - (b) Compared to other technologies, cyclones are the best at removing the very small particles.
 - (c) Among all geometric proportions used in the design of a cyclone, the most critical is the ratio of inlet width (W) to diameter of the main cylinder (D).
 - (d) In a cyclone, a particle twice as large as another has twice as much probability of being removed.
 - (e) Cyclones are characterized by low capital costs and relatively high operating costs.
7. (10 points) 試說明廢棄物焚化處理時，Dioxins 之生成機制，並繪出 Dioxins 之代表化學結構式。
8. (10 points) 試說明 Bag Filter 及 Wet Scrubber 等微粒收集設備之去除機制與特性。
9. (10 points) 試列舉三種整治受污染土壤及地下水之生物處理技術，並說明其原理。
10. (10 points) 已知欲處理之微粒粒徑為 1.5 μm，飄移速度為 0.12 m/sec，收集板面積與氣流流量比為 0.26 (min/m)，請計算靜電集塵器 (ESP) 之收集效率。在氣流流量及飄移速度不改變的情況下，若希望將此 ESP 之收集效率提昇至 99%，則收集板面積必須增加幾倍？