

※ 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. Water becomes scarcer due to climate change. Many countries are failing to satisfy the basic need to provide sufficient quantities of water of acceptable quality. Reclaim water can provide a reliable water source for industry, irrigation, and municipal use.

The treated effluent of a chemical plant contains the following ions: Na^+ 0.02M; Mg^{2+} 0.015 M; Ca^{2+} 0.01M; K^+ 0.001M; Cl^- 0.025M; HCO_3^- 0.001M; NO_3^- 0.002M; and SO_4^{2-} 0.012M

- (a) Please estimate the pH value of this effluent. Please state your reason clearly for full credits. (10%)
- (b) Please determine the osmotic pressure difference across a semipermeable membrane that had this treated effluent on one side and freshwater water (i.e. ion-free water) on the other. The temperature is 25 °C. (10%)
- (c) If you want to obtain 80% of the freshwater production from this effluent, what minimum pressure would be required to balance the osmotic pressure difference that will occur? (5%)
2. Incineration of municipal solid waste almost always implies the burning of some polyvinyl chloride (PVC), a common form of plastic found in construction and many household goods, including packaging and toys. PVC is a polymeric chain repeating a monomer.
- (a) Please write the chemical structure of this monomer of PVC and the reaction describing the high-temperature combustion of the PVC monomer. (7%)
- (b) Calculate the volume of air at $T = 20^\circ\text{C}$ and $P = 1 \text{ atm}$ required to incinerate 2 kg of PVC. Express your answer in liters. (8%)
3. A municipal wastewater treatment plant is processing a waste flow with a 5-day BOD of 200 mg/L at 20° C. If the BOD rate constant k at 20°C is 0.23 day^{-1} , please calculate the ultimate BOD (mg/L) of the raw wastewater at 20°C. (10%)

※ 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。

■ 環境微生物學考題

4. 生活污水中含有蛋白質、氮等物質，如果沒有經過處理就排入承受水體，容易造成水質污染。氮元素有不同價數的氧化態可與其他元素結合，例如胺基酸、氨、硝酸鹽等，環境中的微生物可以代謝這些含氮元素的化合物，使得氮元素不斷地在生態系統中循環，稱為氮循環(Nitrogen cycle)。請繪製出氮循環(10分)，並條列說明構成氮循環的反應(14分)。在環境工程領域，常常應用氮循環反應去除污水中含氮化合物，請試列舉一種生物處理方法，並說明如何轉換水中氮氮變成穩定無害的物質，達到去除污染物的目的(5分)，以及參與其中的各種氮轉換反應的電子供給者、最終電子接受者(6分)，以及一種代表微生物的屬名(genus name)(9分)。
5. 請試說明 Woese 與 Fox (1977)提出的微生物分類系統以及所根據的基因分子(6分)。