1. Explain the following terms: (a) Acidity, (b) TSS, (c) BOD, (d) THMs. (10 %)
2. What is the pH value for acid rain? Please explain why this value is defined according to the calculation from a CO_2-HCO_3-CO_3 system in water. Assuming P_{CO2}=0.000339 atm, Henry's law constant of CO_2 is $3.38x10^{-2}$ (mol/L*atm^{-1}), and $K_{a1} = 4.45x10^{-7}$. (12 %)
3. What are persistent organic pollutants (POPs)? Please show five chemical names of POPs! (8 %)
4. One site was contaminated with 200 mg/kg hexachlorobenzene (HCB). If the required removal of HCB is 90% and the first-order rate constant is 0.5 hr^{-1} at 20 °C, (a) what is the required residence time for the removal of HCB? (b) Due to the sunshine, the temperature increases to 30 °C. Assume the activation energy for the removal of HCB is 10 Kcal/mole. What is the residence time if the desired final concentration is 10 mg/kg? (20 %)
5. **(15%)** The aquatic sediment is often contaminated with heavy metals. The Atomic Absorption Spectroscopy (AAS) is a commonly used instrument for analyzing toxic metals in the environmental samples.

(a) Draw a schematic diagram that shows all of the components of the AAS and explain the function of each component (10 points).

(b) Describe how to conduct the preliminary treatment (e.g., digestion) for contaminated sediment before using AA analysis for metal quantification (5 points)

6. **(15 %)** Complete the chart shown in the outline below:

Element	Common ionic forms present in the environment	Common metal-organic forms	Most toxic forms
Mercury			
Lead			
Cadmium			
Arsenic			
Chromium			

7. **(5 %)** What are emerging pollutants? Define the term environmental hormones.
8. **(5%)** Please explain the mechanism (how and when) of the ozone depletion in Antarctic. In addition, please explain why the ozone depletion is more severe in the Antarctic than in the Arctic.
9. **(10%)** What are aerosols? What is $PM_{2.5}$? Please explain why the concentration of aerosols (e.g., $PM_{2.5}$) is higher in southern Taiwan. List at least three possible causes (e.g., sources of pollutants)

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