1. In November 2024, the United Nations Climate Change Conference (COP29) was held in Azerbaijan, bringing together nations worldwide to discuss strategies for achieving the global net-zero carbon emissions target by 2050. During the conference, nations reaffirmed their commitment to accelerating energy transition, advancing carbon capture, utilization, and storage (CCUS) technologies, and establishing stricter greenhouse gas (GHG) reduction standards. Although many countries face the challenges of balancing economic growth with environmental sustainability during the emission process, reducing reliance on fossil fuels and promoting energy transition has long been one of the core objectives of COP meetings.
What are greenhouse gases (GHG)? Besides carbon dioxide (CO_2), what other chemical substances are considered greenhouse gases? Why is carbon dioxide equivalent (CO_2e) commonly used as a unit of measurement when discussing GHG emissions? (10 pts)

2. Building on the previous question, fossil fuels not only contribute to the greenhouse effect but also emit air pollutants. A coal-fired power plant burns 10,000 tons of anthracite coal ($C_{100}H_{40}O_{1.5}N_{0.5}S_{0.1}$) per day under conditions of 10% excess air. Exhaust gas analysis shows that all sulfur is emitted as sulfur dioxide (SO_2), and all nitrogen is emitted as nitric oxide (NO). In addition, the exhaust gas contains 50 ppm of NO. Given that the combined Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR) processes achieve a removal efficiency of 90% for NO, please calculate the total daily emissions of SO_2 and NO released into the atmosphere. Based on the formation mechanism of NO, determine the primary type of nitrogen oxides (NOx) to which this NO belongs. (10 pts)

3. Assuming the river water has the same pH value, compare the sediment environments of the upstream and the tidal river segment. In which segment is $Fe(OH)_3(s)$ more likely to dissolve? Please explain based on the environmental characteristics of the river and the principles of chemical reactions. (10 pts)

4. Lead (Pb) is a heavy metal with severe adverse impacts on health. In wastewater treatment, chemical precipitation is commonly used to remove dissolved divalent lead ions (Pb^{2+}) by adjusting the pH. Assuming the presence of excess $Pb(OH)_2(s)$ in water at equilibrium, please calculate the solubility of lead (Pb) at pH = 8.0 (Pb: 207.2 g/mole). Please consider the following reactions and equilibrium constants. (10 pts)

   $Pb^{2+} + OH^- \leftrightarrow Pb(OH)^+$ ($K_1 = 10^{6.3}$)
   $Pb^{2+} + 2OH^- \leftrightarrow Pb(OH)_2(aq)$ ($K_2 = 10^{10.6}$)
   $Pb^{2+} + 2OH^- \leftrightarrow Pb(OH)_2(s)$ ($K_3 = 10^{15.2}$)

5. What role does ammonia (NH_3) play in the formation of atmospheric aerosols in urban areas? Please explain using chemical reaction equations. (10 pts)

6. How are CFU (Colony Forming Units) and MPN (Most Probable Number) used to quantify microorganisms in environmental samples? Explain their significance. (10 pts)

7. What is the role of microorganisms in ecosystem restoration, such as restoring degraded soil or aquatic ecosystem? (20 pts)

8. What is antimicrobial resistance, where does it originate, and how can we minimize its impact and prevent its spread? (20 pts)