General Instructions:
• On this exam, you may use the course text, your own notes, and any homework solution sets that you have personally written.
• Be sure to show all steps, list units, and state all assumptions clearly for maximum credit.

1. (150 pts) A power plant (37% efficient) uses a liquid fuel that can be approximated to have the following chemical formula

\[ C_{24}H_{49}O_{0.01}N_{0.06}S_{0.06}X_{0.1}Y_{0.065} \]

Where X and Y represents non-combustible bottom ash (X) and fly ash (Y). During combustion, assume N forms NO, S forms SO\(_2\), and that X and Y are already completely oxidized. The overall molecular weight of the fuel is 393. The fuel has a heating value of 15,800 BTU/lb.

A. Find the stoichiometric amount of added oxygen (in grams) required to completely oxidize the fuel. Molecular weights C = 12, H = 1, O = 16, N = 14, S = 32, X = 160, Y = 92

B. Calculate the mass of air needed if the equipment runs fuel lean by a mass based factor of 1.05. What is the air to fuel ratio?

C. Determine if any pollution control equipment is needed using NSPS for fossil-fuel electric utility steam generating units (1980). Assume that 50% of NO released originates with fuel N.

2. (100 points) Consider the papers I distributed by e-mail “What every European Should Know About Global Warming” by the Competitive Enterprise Institute and “From Papal Indulgences to Carbon Credits: Is Global Warming a Sin?” Choose two of their stronger points and discuss its validity or lack thereof based on the material presented in class from the two IPCC reports and the Environment and the Economy paper.

3a. (10 pts) List the primary air pollutants.
3b. (40 pts) Choose one primary pollutant and give a detailed discussion concerning its role as an air pollutant [I am expecting about \( \frac{1}{2} \) to 1 page of double space, legible, large font text]. You may want to include (but do not limit yourself to only these topics if you want full credit)
   • How it is discharged into the air (sources)?
   • What happens to it after it enters the air (ultimate fate)?
   • Why it is considered a pollutant (effects)?