1. The U.S. consumes $1.3 \times 10^{10}$ GJ of electrical energy each year. Of this, about 45% is from coal burning power plants. About 600 lbs, 0.3 tons, of CO2 are released for each GJ of electricity produced by burning coal while about half of this, 300 lbs, 0.15 tons, of CO2 are released for each GJ of electricity produced by burning natural gas. The total amount of CO2 released by the US is 6 Gtons per year.

a) If all the coal burning power plants in the U.S. were replaced by natural gas burning ones operating at the same efficiency as the coal plants, by what percentage would the CO2 emission of the U.S. be reduced?

b) In a) we assumed that coal and combined-cycle natural gas plants operate with the same efficiency, but this is in fact not the case. The efficiency of a combined-cycle natural gas plant is 60% while the efficiency of most existing coal power plants is 33%. If all of the coal burning power plants in the US were replaced by combined-cycle natural gas ones, by what percentage would the CO2 emission of the US be reduced? Please note that because the efficiencies of the two types of plants are different, different amounts of energy are required to produce the required electrical energy that you found in a) (where the excess is heat).
c) What is a combined-cycle natural gas plant?

2. In “Climate Change: Evidence and Causes”, the evidence supporting climate change is presented as primarily quantitative where there is bound to be some scientific uncertainty. The authors of this document cite cloud dynamics as a cause of uncertainty in the data. Please name three (3) other causes of scientific uncertainty and explain specifically which data from this publication (e.g. specific figures) could be affected.

3. In class we have discussed how climate change leads to sea level rising, and how this phenomenon can cause major sociological problems across the world. Using “Climate Change” as a resource, name three (3) other ways climate change disturbs the Earth’s natural climatological balance. What sociological problems could result from these climatological disturbances?