CHEM4397—Energy: Consumption, Production, Conservation

First Midterm

Prof. Ognjen Š. Miljanić

Name: _____

(print legibly) Last First

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Last 4 Digits of Student ID Number: _____

Read all directions very carefully. Write your answer legibly in the designated spaces and think about what you are doing. Give only one answer for each question. Total number of points is 200.

1. (25 points) Explain, in your own words, why is the embodied energy of aluminum about 300 MJ kg^{-1}, while that of steel is only around 30 MJ kg^{-1}. Make sure to consider all the factors.

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FINAL SCORE

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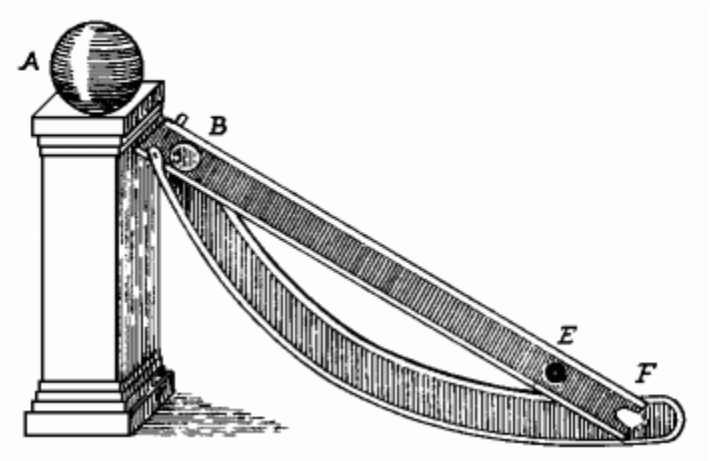
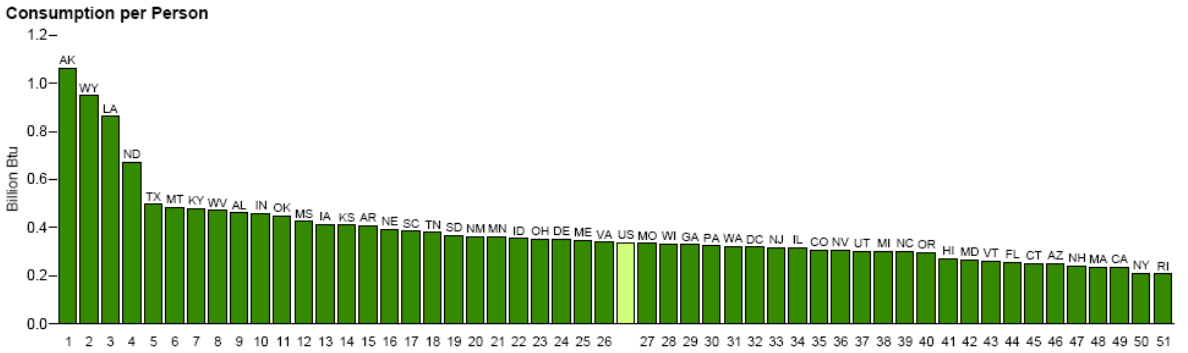
2. (30 points) An energy-efficient refrigerator consumes energy at the rate of 280 W when it's actually running, but it's so well insulated that it runs only about one-sixth of the time. You pay for that efficiency up-front, since such a refrigerator costs $950. A conventional refrigerator costs $700, but it consumes 400 W when running, and it runs one-fourth of the time. Calculate the total energy used by each refrigerator over a 10-year lifetime and then compute the total costs—purchase price plus energy cost—assuming electricity costs 10 ¢ per kWh. Show your work.

3. (40 points) Examine this proposed *perpetuum mobile*, designed by Bishop John Wilkins (1614–1672), who was a founder and first secretary to the British Royal Society. It consists of two tilted ramps, an iron ball, and a magnet fastened at the top. The magnet at the top (**A**) should pull the ball (**E**) up the straight ramp, where it would fall through the hole (**B**) to the lower ramp, roll down, and—through another hole (**F**)—return to the straight ramp where it would be pulled up again. Why doesn't this work?



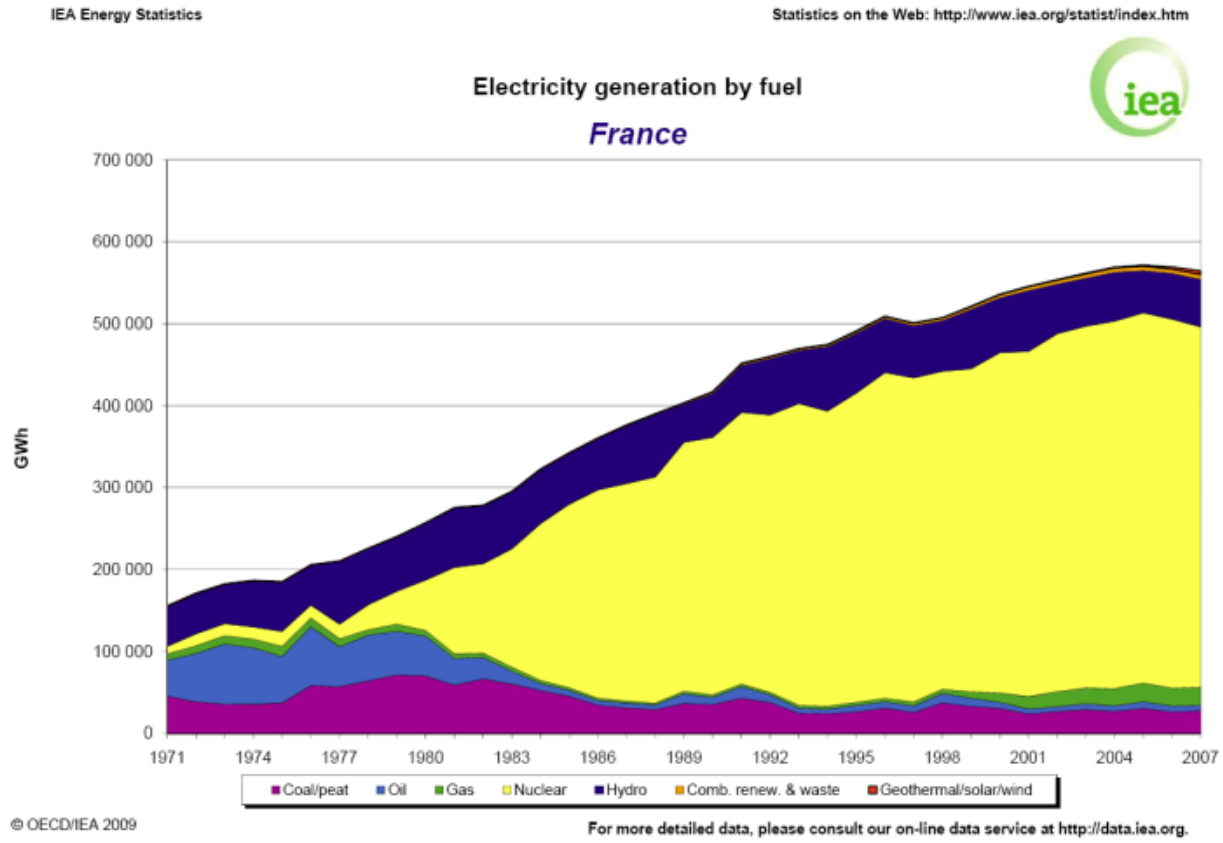
4. (40 points) Analyze the graph below, take from the EIA website. Do certain values surprise you? Write three sentences with the general observations about these trends. Then provide your opinion on the possible causes of disparities in energy consumption in pairs of apparently similar states such as ND/UT, LA/TX, AK/TN, and TX/AZ.

Figure 1.6 State-Level Energy Consumption and Consumption per Person, 2007



5. (15 points) In 1965, the world's population was about 3.4 billion and was growing at about 2 percent annually. In 1985, the population was 4.9 billion, growing at 1.7 percent, and in 2000 it was 6.1 billion, growing at 1.2 percent. In which of these three years did the actual number of people increase by the greatest amount? Show by calculating the number in each case.

6. (30 points) The following graph shows the distribution of different fuels used to produce electricity in France. Briefly describe the trends and comment on the possible causes, paying attention to time periods.



7. (20=4×5 points) Succinctly define, in your own words, the following concepts:

Energy intensity

Primary energy

Embodied energy of a material

Octane number

EXTRA SPACE. CLEARLY INDICATE THE PROBLEM(S) YOU ARE SOLVING ON THIS PAGE.