Always express energy in Joules unless otherwise specified. The website http://www.iea.org/Textbase/stats/unit.asp may help with unit conversions.

1. (5 points) Using the logic from page 20 in the text, calculate the concentration of CO$_2$ in the atmosphere if all recoverable fossil fuels were burned. Approximate the current concentration as 370 ppm (by volume). Note: the logic from page 20 implicitly assumes that all fossil fuels combust according to the petroleum row in table 2.2 on page 25 of the text and that any addition to or subtraction from the atmosphere is not countered by any feedback mechanism (e.g. increasing the amount of CO$_2$ in the atmosphere does not increase the flow of CO$_2$ to the oceans). HINT: you will need to convert the mass of air to the number of moles of air.

2. (10 points) Compare the performances of delivering heat energy for the following two cases.

   (a) A power plant consumes a fossil fuel and produces electricity with 40% efficiency. This electricity is then supplied (without loss) to a house equipped with a heat pump having a theoretical efficiency of 4.0.

   (b) The house directly uses that same fossil fuel for heating at 100% efficiency.

You should find the two processes require different amounts of energy to supply the same amount of heating power to the house. Which requires less energy? Explain qualitatively why this difference is not a violation of the law of conservation of energy.

3. (10 points) In one paragraph each, make a case for and against drilling in ANWR. In a third paragraph, state in which position you believe and defend why you have taken that position. After you have done this, go to the web and identify a politician who shares your position and justification (as close as possible - site your web source). For the sake of the graders, please be succinct as always.

4. (15 points) You’re interested in an electric car recently made available, and the salesperson claims that the cost of powering the vehicle is less than the cost of powering a similar, gas powered car. Being a skeptic (and a good scientist), you decide to check out her claim. Assuming the price of electricity if $0.07 per kWh, the price of gasoline is $2.19 per gallon, and that the electric and gas powered cars run at 75% and 25% efficiency, respectively, determine which car is cheaper to power. Take the weight of gasoline to be 5.51 lb/gal and its energy release on combustion to be 19,000 BTU/lb (adapted from problem 8 of part I of the text). Describe at least one disadvantage for each powering method.

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5. (10 points) A wind power density of 300 W/m$^2$ at an altitude of 50 meters can be found in twenty-one percent of the land in the contiguous 48 states. If a 50 meter tall windmill with a rotor diameter of 50 meters could be built with wind-to-electricity conversion efficiency of 25%, how much of the contiguous 48 states’ electricity consumption could be supplied by wind power if 30% of this “arable” land were filled with windmills at a density of 8 windmills/km$^2$? Take the land area of the contiguous 48 states to be 7,827,989 km$^2$ and the electricity consumption to be 3236 TWh per year (adapted from problem 24 of part I of the text). Describe any disadvantages to this plan.

6. (10 points) Describe a method of carbon sequestration and discuss the problems/issues/unknowns involved with that method.