Assignment #1 - 10 points

Due Tuesday, February 4, 2003

1. Energy and CO₂. (6 points)

Write down a rough estimate of the number of miles that you travel in gasoline-driven vehicles each year.

a) (1 pt) What is your corresponding rate of fuel consumption (in kg/yr)? (Use the following facts to make ratios of units, flipping them until all the units you don’t want cancel out: Assume that you get 25 miles/gallon, 1 gallon ≈ 4 liters, 10³ liters = 1 m³, and gasoline has a density of ≈ 10³ kg m⁻³).

b) (1 pt) From your answer in a), how many kg CO₂ are emitted per year by your fuel consumption (kg CO₂/yr)? (CO₂ and H₂O gas are emitted when gasoline is burned. Carbon makes up about 80% of the mass of gasoline. The atomic weight of C is 12; O is 16.)

c) (1 pt) Your answer to b) should be larger than for a). Where does the extra mass come from?

d) (1 pt) Compare the mass of CO₂ emitted per year from part b) to the mass of a typical car (about 2000 lb). 1 kg ≈ 2.2 lb.
e) (1 pt) What is your rate of energy consumption via burning gasoline? (units will be in Watts) Burning 1 kg of fossil fuel gives off about 50 million Joules of energy. (This is similar to “burning” a kg of food fuel in your body through respiration.) The energy content of gasoline is about 50 x 10^6 J/kg. There are about 3x10^7 s in a year. 1 W = 1 J/s = 1 Joule per second, a unit of power.

f) (1 pt) If you instead used the energy in part e) to keep light bulbs shining all year, how many 100 W bulbs could you keep going? (You might want to also think about this relative to burning food in your body, which gives off power equivalent to one 100 W bulb all the time in the form of infrared radiation!)

2. Population and Fossil Fuel Use (4 points)

We can make a forecast for the population of our planet and fossil fuel energy use into the next century by using data from *Vital Signs*, attached as Tables A and B.

a) (1 pt) In the first week of class we discussed a figure (also in Gore) showing that our population is growing exponentially. From the Table A, what is the approximate “doubling time” for our population, beginning in 1950?

b) (1 pt) If the doubling time found in a) remained the same into the next century, about how many people would there be in the year 2100?
c) (1 pt) Given the data in Table B, what were the rates of fossil fuel usage in equivalent oil per person (kg/yr-person) in 1950 and 1996? (1 ton = 2000 lb., 1 kg = 2.2 lb)

d) (1 pt) If the rate of equivalent oil usage increased into the next century roughly at the linear rate suggested in Table B, estimate the consumption rate per person in the year 2100. (Use the slope-intercept formula for a line and two data points, or make a graph from the data and extend it with a ruler.)