
Problem Set 2Due **before class** Thursday, 14 October 2010**Homework Problems:**

1. **A cure for global warming?** If all the governments in the world required all buildings to have white roofs instead of the more common dark colored ones, by how much would the earth's temperature be decreased?
2. **Unintended consequences?** Changing dark roofs to light roofs will reduce the heat absorption of the roofs and thus increase the home heating requirements in cold climates.
 - Estimate the fractional increase in global fossil fuel burning this need for extra home heating would cause.
 - Over 50 years, how much would this extra heating increase global warming (i.e what additional δT would it cause compared to the same circumstances but without white roofs). Hint: Burning of fossil fuels has increased the level of CO_2 in the earth's atmosphere from 2.7×10^{-4} in the 1800s to 3.1×10^{-4} in 1960 to 3.9×10^{-4} in 2010. Though the feedback is complicated, this seems to have increased the mean temperature on earth by 1 – 2K.
3. **All steamed up** When you boil a pot of water on a natural-gas range, the kitchen steams up. What fraction of this water vapor is from the pot, and what fraction is from combustion of the natural gas?
4. **The Astronaut diet** Would the energy of all the calories you have consumed as food be enough to eject you from the solar system?
5. **Lead poisoning.** First some facts: Tetraethyl lead was used as an octane booster in gasoline between 1929 and 1986 (when it was banned in the US for automobile use), at a concentration of about 5 grams of lead per gallon of gas. Most of that lead was exhausted in small soot particles which settled near roads (directly onto the ground and onto shrubbery and the walls of buildings, where rains washed it to the ground). Also, exterior house paint used before 1978 in the US had lead concentrations of 5-10% by weight. Lead is a potent neurotoxin which binds to hemoglobin in the blood. It takes about a month for lead levels in the blood to change (about equally by excretion and by storage in the bones and teeth). Clinical symptoms (fatigue, muscle pain and reduction of IQ) appear when the lead levels in blood reach $100\mu\text{g/liter}$; coma and death occur at ten times that level. Now the problems:
 - a) Estimate the total mass of lead spread over the city of Pasadena. Assume that this is mixed into the top 2 cm of soil in Pasadena. How much Pasadena dirt can a toddler safely suck off his or her fingers per day and still avoid lead poisoning?
 - b) A typical Pasadena-area house was constructed in 1920. Assuming sanded paint is also concentrated in the top 2 cm of soil around the house, estimate the lead concentration in the dirt there due to accumulated house sandings and scrapings, and compare to (a).