Homework #1

1. For a hydrocarbon with a molecular formula of C_nH_m, balance the combustion equation:

   $$C_nH_m + O_2 \rightarrow CO_2 + H_2O$$

2. We typically see heats of combustion in units of Btu/lb or Btu/mole (in terms of US customary units). When dealing with transportation fuels we also are interested in knowing the combustion energy available for every unit volume (since fuel tanks are typically a fixed volume). Determine the energy density (liquid fuel's 77°F net heating value in Btu per 60°F gal) for the following pure components. Use data from *PureComponentData.xls* available on the class web page.
   - n-Hexane
   - Cyclohexane
   - Benzene
   - n-Heptane
   - 2,2,4-Trimethylpentane (i.e., isooctane)
   - o-Xylene
   - n-Decane
   - Naphthalene
   - n-Hexadecane
   - n-Eicosane

3. Gasoline is typically made up of hydrocarbons that boil between 90°F and 400°F with an average near 250°F. Diesel is typically made up of hydrocarbons that boil between 300 and 600°F.

   Let's consider isooctane as a model compound for gasoline and n-hexadecane for diesel. Which has a higher energy density, gasoline or diesel?

4. For the components in problem #2 determine the amount CO_2 produced per gallon of fuel burned. Assume complete combustion.

5. In a recent editorial in the *Denver Post*[1] it is stated that a Toyota Prius emits 0.26 lb CO_2 per mile driven compared to an average passenger car which emits 0.54 lb CO_2 per mile driven. Are these numbers reasonable? State all of your assumptions & clearly state how you've done the calculation.

[1] "Prius Effect" by Chuck Plunkett, the *Denver Post*, August 16, 2009.