Answer the following questions related to hydrocarbons.

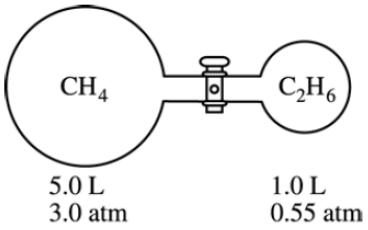
a) Determine the empirical formula of a hydrocarbon that contains 85.7 percent carbon by mass.

b) The density of the hydrocarbon in part (a) is 2.0 g L^{-1} at 50ºC and 0.948 atm.

(i) Calculate the molar mass of the hydrocarbon

(ii) Determine the molecular formula of the hydrocarbon

c) Two flasks are connected by a stopcock as shown below. The 5.0 L flask contains CH_4 at a pressure of 3.0 atm and the 1.0 L flask contains C_2H_6 at a pressure of 0.55 atm. Calculate the total pressure of the system after the stopcock is opened. Assume that the temperature remains constant. Ans: 2.6 atm



d) Octane, $C_8H_{18}(l)$, has a density of 0.703 g mL^{-1} at 20ºC. A 255 mL sample of $C_8H_{18}(l)$ measured at 20ºC reacts completely with excess oxygen.

(i) Write the balanced combustion equation for octane

(ii) Calculate the total number of moles of gaseous products formed

(iii) Given the enthalpy of formation of octane, ΔH_f = -250 kJ/mol and enthalpies of formations from Appendix C calculate the amount of energy released by the combustion of 255 mL of octane. Ans: -7979 kJ

(iv) If the energy above is given to a sample of water and assuming no loss to the surroundings, what mass of water can be heated from 21ºC to normal boiling point? Ans: 24.2 kg