[pex45] Water solubility of hydrocarbons

The hydrophobicity of some linear hydrocarbons is expected and observed to increase with carbon content. This attribute is incorporated into the model free-energy density

$$f(T,\phi) = \frac{k_B T}{v_c}\Big[\phi\ln\phi + (1-\phi)\ln(1-\phi) + \chi\phi(1-\phi)\Big]$$

by an interaction-energy parameter (at room temperature) that depends on the number n_C of carbon atome in a hydrocaron as follows:

$$\chi = 3.04 + 1.37 n_C.$$

Find the solubilites in water thus predicted by this model for hexane (C_6H_{14}), octane (C_8H_{18}), and decane ($C_{10}H_{22}$).

[adapted from Jones 2002]

Solution: