

**Carnegie Mellon University**  
**Department of Civil and Environmental Engineering**

**12-725: Fate, Transport, and Physicochemical Processes of Organic Contaminants  
in Aquatic Systems and their Measurement in Environmental Samples**

**Problem Set #5 Spring 2020**  
**Due March 5, 2020 by 5pm**

1. Describe the general chemical and structural features of “organic matter” in the environment. What are the primary sources of organic matter in the environment? What are the main differences between soil organic matter (SOM), particulate organic matter (POM), and dissolved organic matter (DOM)? What are the primary thermodynamic driving forces for sorption of organic compounds to organic matter from air and water?
2. Q13.2 and Q13.7 in EOC
3. P13.2 and 13.7 in EOC
4. A) Consider an environment consisting of air, water, soil, sediment, suspended aquatic matter, and biota. Beginning with a system mass balance, derive general expressions for the fraction of mass of a species in each phase in terms of the dimensionless partition coefficients,  $K_{i,x}$ , between phases (e.g. Henry’s Constant,  $K_H$ ) and the phase volumes ( $V_a$ ,  $V_w$ ,  $V_{soil}$ ,  $V_{sed}$ , etc.).  
  
 B) Using your equations (model), calculate the partitioning (i.e. fraction of the compound in each phase) of the following compound in an environment with the following properties:

**Compartment Properties**

	<b>Volume</b>	<b>Density</b>	<b>Organic Fraction</b>
	<b>[m<sup>3</sup>]</b>	<b>[kg/m<sup>3</sup>]</b>	<b>[--]</b>
<b>Air</b>	<b>2.00E+09</b>	<b>1.19E+00</b>	<b>N/A</b>
<b>Water</b>	<b>9.90E+05</b>	<b>1.00E+03</b>	<b>N/A</b>
<b>Soil</b>	<b>1.40E+04</b>	<b>1.50E+03</b>	<b>2.00E-02</b>
<b>Sediment</b>	<b>9.90E+03</b>	<b>1.50E+03</b>	<b>4.00E-02</b>
<b>Susp. aq matr</b>	<b>3.50E+01</b>	<b>1.50E+03</b>	<b>4.00E-02</b>
<b>Biota</b>	<b>3.50E+00</b>	<b>1.00E+03</b>	<b>24% lipid</b>

5. P16.2 in EOC