Part I
Phase Distribution

$$M_W = C_W * porosity * saturation$$
$$M_s = K_d * C_W * \rho_s = 0.6 f_{oc} k_{OW} * C_W * \rho_s$$
$$M_a = C_W * K_H * porosity_{air}$$

Benzene

$$M_W = 1770mg/L * 0.3 * 0.5 = 265.5mg/L$$
$$M_s = 0.6 * 0.01 * 134.9 * 1770mg/L * 1.29g/cm^3 = 1848.1(mg/L)(g/cm^3)$$
$$M_a = 1770mg/L * 0.22 * 0.15 = 58.41mg/L$$
$$M_{total} = 2172.01$$
$$M_W = 12.2\%$$
$$M_s = 85.1\%$$
$$M_a = 2.7\%$$

Butanone

$$M_W = 26800mg/L * 0.3 * 0.5 = 4020mg/L$$
$$M_s = 0.6 * 0.01 * 1.82 * 26800mg/L * 1.29g/cm^3 = 377.526(mg/L)(g/cm^3)$$
$$M_a = 26800mg/L * 0.001 * 0.15 = 4.02mg/L$$
$$M_{total} = 4401.55$$
$$M_W = 91.3\%$$
$$M_s = 8.6\%$$
$$M_a = 0.1\%$$

The water solubility term appears first order in all three phase distribution expressions, so it does not have an effect on the distribution. Henry's constant is first order in the gas phase, so increasing Henry's constant will favor distribution in the gas phase. The octanol-water partition is first order in the solid phase, so a higher k_{OW} will increase the amount in the solid phase. Generally, more polar molecules will be more soluble in water than less polar molecules.
Benzene is a nonpolar volatile hydrophobic compound, so it prefers the solid state, with very little going into the aqueous phase. A comparatively high amount of benzene is in the gas phase because of its high volatility. By comparison, MEK is much more hydrophobic and less volatile, and its carbonyl group imparts a not insignificant dipole moment.. It partitions more in the aqueous phase and less in the gas or solid phases.
The addition and removal of water is analogous to any other phase partitioned extraction. Assuming each addition and removal of water allows for the system to equilibrate and all water is removed:
Benzene:
$1 - (1 - 0.122)^3 = 32.3\%$
Butanone:
$1 - (1 - 0.913)^3 = 99.9\%$

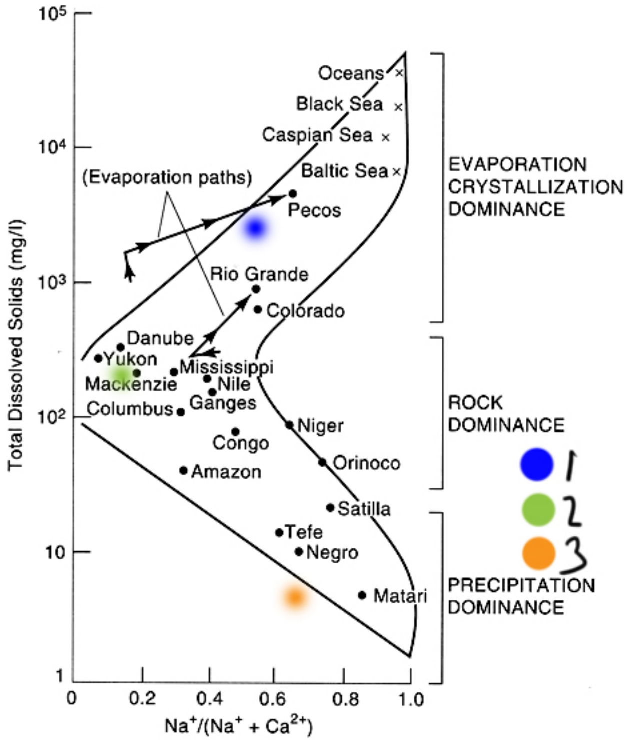
Part II
Suspended Sediment Load

The amount of suspended matter in a river is controlled by the relief and area of the drainage basin, the amount of water discharge, the climate, the geology of the river basin, and the presence of lakes or reservoirs along the length of the river. The majority of the suspended sediment transport by rivers into the ocean occurs in Asia and the Pacific Islands because of the relief of the drainage basin. The Himalayan plateau is tectonically active, and the gradients of the rivers are consistently steep, which decreases the deposition of suspended matter along the length of the river. The Pacific Islands also have relatively high elevation and a low surface area.

Part III

Dissolved Chemical Composition

River	Sodium	Calcium	Ratio	TDS
1	207	310	0.5996	2015
2	33	7	0.175	211
3	0.2	0.4	0.6667	6.3



1 is evaporation-crystallization, 2 is rock, and 3 is precipitation.

Part IV

Box Model

$$C_i = (CF_o + R_s)/F_i$$
$$200m^3s^{-1} = (1.5mgNiL^{-1}(170m^3s^{-1}) + R_s)/2.0mgNiL^{-1}$$
$$R_s = 145gNi/s$$

Part V
Seasonal Cycles

During the summer and winter, a freshwater dimictic lake is thermally stratified, but during the spring and fall, the water temperature is consistent throughout. Because this is a freshwater lake, temperature is the dominant control on density. As such, the water during the fall and spring is isopycnal and readily mixes throughout. In the epilimnion, pH and redox potential are high while nutrient concentrations are low. In the hypolimnion, pH and redox potential are low while the nutrient concentration is high.

Part VI
Saline Lakes

The formation of saline lakes is favored when the climate is arid to semiarid, and there is no outflow of water to remove the dissolved salts. Water is removed from the lake by evaporation, concentrating salts in the remaining water. Saline lakes are often alkaline due to weathering and precipitation processes. Bicarbonate in water is balanced by sodium, potassium, magnesium, and calcium. During evaporation, magnesium and calcium preferentially precipitate while sodium and potassium stay in solution. This causes excess bicarbonate to be built up in the water, raising pH. Magnesium and calcium are preferentially precipitated out with bicarbonate, while potassium and sodium remain in solution. Sulfate is most likely from mineral weathering as well. Sulfate concentrations increase as sulfate is replaced by bicarbonate as a counterion for magnesium and calcium minerals. Generally, sulfates are more water soluble than carbonates. Aluminium is less soluble in high pH conditions as well, preferring to form aluminium oxides. Sodium and potassium tend to stay in solution while calcium and magnesium precipitate out, causing sodium and potassium concentrations to be elevated and calcium and magnesium concentrations to be depressed in saline lakes relative to acidic freshwater lakes where carbonates readily dissolve.