(1) Define the following terms and describe their significance in environmental science. (20%)

(a) Debye-Huckel limiting law

(b) electron activity

(c) algae bloom

(d) aerosol

(e) humic substance

(2) A radioactive waste contains 2 curies of ^{99m}Tc/liter and 2 millicuries of ^{45}Ca/liter. The waste can only be charged when its total activity is less than 20 microcuries/liter. Please determine the storage time of the waste before it can be discharges. Assume that the radwaste follows first-order decay and half-lives of ^{99m}Tc and ^{45}Ca are 6 hrs and 152 days, respectively. (15%)

(3) The reaction $O_{2(g)} \leftrightarrow O_{2(aq)}$ has an equilibrium constant (K_H= 1.29×10^{-3} at 25°C). The vapor pressure of water at 25°C is 23.8 mm-Hg and that dry air is 21 percent of O_2 by volume. Please determine:

(a) The equilibrium concentration of oxygen in pure water. (10%)

(b) The equilibrium concentration of oxygen in Pacific Ocean water with the ionic strength of 0.7 and salting-out coefficient of 0.132. (5%)

(4) Acidification is mainly a problem in lakes with poor buffering capacity. The addition of limestone ($CaCO_3$) to the lakes has proven to be effective on the neutralization of the acid . A lake containing 5.5×10^7 m^3 of water is at pH 4.5. Please determine what mass of limestone is needed to be sprayed onto the surface of this lake to bring the pH to 5.8, if all the acidity is in the form of free H^+.(15%)

(5) The mass of the atmosphere is about 5×10^{15} tones. The concentration of 1,1,1-trichloroethane in the atmosphere is currently 0.15 ppbv. Please calculate the mass of 1,1,1-trichloroethane in the atmosphere. (15%)

(6) Please delineate the mechanisms of the formation and destruction of ozone (O_3) in stratosphere and troposphere, respectively. (10%)

(7) A tetrachloroethylene (PCE) is present at a concentration of 1.8 ppm in water. A 5.0 L sample of water is extracted quantitatively using three successive 100 mL portion of pentane. The pentane extracts are combined and evaporated to a final volume of 2 mL. Please calculate the concentration of PCE in the final solutions by assuming the K_{oc} of PCE is 400. (10%)
(K_{oc} =concentration of pyrene in organic carbon/concentration of pyrene in water).