Name:_____

CHE 362 **Exam #1** **2/19/20**

Part II – Open Notes

#5 (50 pts) Water in a fish hatchery is to be oxygenated by bubbling air through the water. For a bubble of gas rising through a liquid, the mass transfer coefficient on the liquid side has been correlated with the following equation:

$$Sh_L = 2 + 0.6\,\mathrm{Re}_L^{1/2}\,Sc_L^{1/3}$$

where the characteristic length is the bubble diameter.

For the gas side, the correlation is $Sh_G = 10$, where the characteristic length is the bubble diameter.

Estimate the liquid phase and gas phase mass transfer coefficient for a 1 cm bubble of air rising at a rate of 0.2 m/s through water at a temperature of 298 K and pressure of 1 atm.

Properties of the liquid and gas:

	Liquid	**Gas**
Density (kg/m^3)	1000	1.184
Viscosity (kg/m sec)	9.227*10^{-4}	1.845*10^{-5}
Diffusivity (m^2/sec)	2.10*10^{-9}	2.10*10^{-5}
Molecular weight (gm/mol)	18	29

R = 8.206*10^{-5} m^3 atm /mol K

k_x = 2.5 mol/m^2·s

k_y = 0.859 mol/m^2·s

#6 (36 pts) In a tank used to absorb O_2 from air into water, the following mass transfer coefficients have been predicted:

$k_x = 3$ mol/m^2 sec

$k_y = 1$ mol/m^2 sec

At one point in the column, the mole fraction of O_2 in the water is 10^{-6} and in the gas is 0.2. The column is operated at 1 atm pressure and the Henry's Law (pp = H x) coefficient for O_2 in water is H = 43,800 atm. You can assume a low mass transfer rate.

a) Find the mole fraction of O_2 in each phase at the interface.

$x_i = 4.566 \cdot 10^{-6}$

$y_i = 0.1999$

b) Calculate the flux of O_2 from the gas to the liquid.

$N_A = 1.07 \cdot 10^{-5}$ mol/m^2 sec

c) Find the % resistance to mass transfer in each phase.

$K_x = 3$ mol/m$^2 \cdot$s

$K_y = 6.85 \cdot 10^{-5}$ mol/m^2 sec

Liquid phase = 99.993% resistant Gas phase = 0.007% resistance