Bio390 **Problem: Solubility (SOLUTIONS)**

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1. Calculate how much oxygen will dissolve in one liter of fresh water at sea level (i.e., P_b = 760 mm Hg). Assume the air is saturated with water vapor (look in notes), the temperature is 20°C, and oxygen constitutes 20.94% of the volume in of the dry fraction of the air. The solubility coefficient for oxygen in water at 20^o C is about 31 mlO_2 / (liter H_2O * atm)

From the notes: P_{H2O} at 20 C when saturated = 17.5 torr.
Rcall that O_2 and other gases (except water vapor) are always given as either *F* or % on a dry gas basis. Therefore

$P_{O2} = (P_b - P_{H2O}) * \%O_2 / 100 = (760 - 18)$torr * 20.94/100 = = 742 torr * 0.2094

P_{O2} = 155 torr

At equilibrium, the amount of O_2 that will be dissolved(D_{O2}) is:

$D_{O2} = \alpha_{O2} * P_{O2}$ = 31 ml O_2 / (liter H_2O * atm) * 155 torr* 1 atm/ 760 torr

D_{O2} = 31 ml O_2 / (liter H_2O * atm) * 0.2039 atm

D_{O2} = 6.3 ml O_2 / liter of water.

Note that this corresponds to 0.6 ml O_2 per dl (100 ml) of water; a set of units we will more commonly use when we discuss blood gas transport. Actually, since in mammals the blood is typically between 36 and 39C, the amount of O_2 carried in solution is only about half that (around 3 ml O_2 / dl plasma

2. Calculate how much oxygen will dissolve in one liter of fresh water at an altitude where the barometric pressure is 450 mm Hg. Again assume the air is saturated with water vapor, the temperature is 20°, and oxygen constitutes 20.94% of the volume in air on a dry gas basis.

Just like before except that the pressure is 450 torr.

$P_{O2} = (P_b - P_{H2O}) * \%O_2 / 100 = (450 - 18$ torr)*0.2094 = 432*0.2094=90 torr

$D_{O2} = \alpha_{O2} * P_{O2}$ = 31 ml O_2 / (liter H_2O * atm) * 90 torr* 1 atm/ 760 torr

= 3.7 ml O_2 /liter H_2O